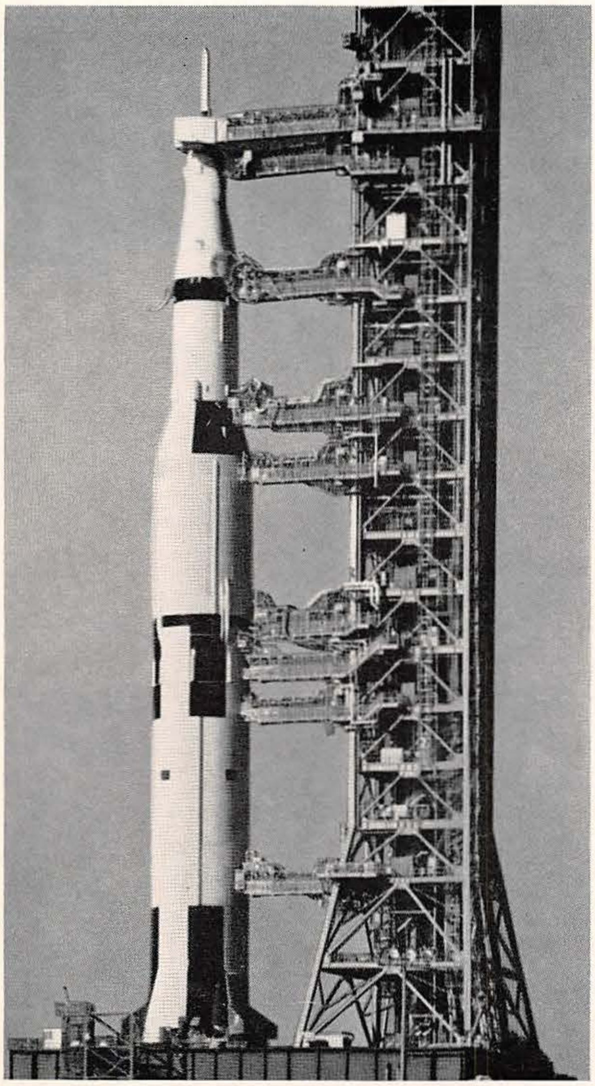
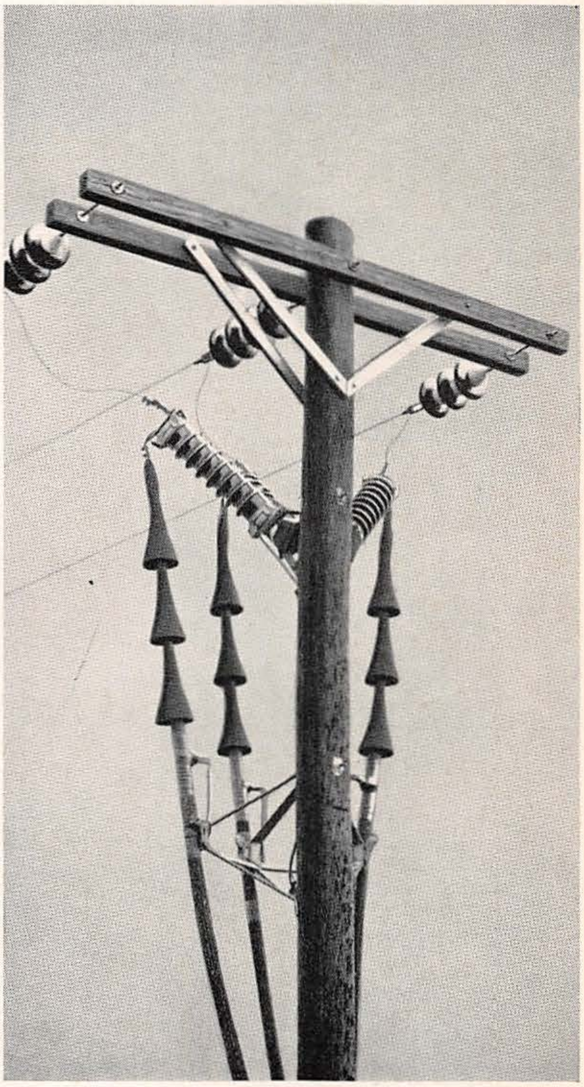
SEPTEMBER, 1968

Railway Signaling & Communications





The latest, and the greatest thing in space...

Some things are brand new, and they change drastically from month to month. It takes time to effect improvements, and in something as new as tomorrow, like our space program, you can expect change to be the order of the day.
If you're concerned with important things like riser cables, this could keep you up in the air...

The earliest, and still the greatest thing under the sun.

Some things are tested by time and yet remain as modern as tomorrow's utility. Kerite riser cables are a prime example of this great advantage. You don't have to spend time to test them. Kerite and the users of electric power already have. There has been over 40 years of experience with Kerite riser cables in all climates at a wide range of voltages including the 46,000 volt rated cable shown above.

MEMBER RPI Kerite
the cable that lasts... and lasts... and lasts...

The Kerite Company · Principal Offices: New York, Chicago, Seymour, Connecticut · Sales Representation Throughout the United States.

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UNILENS

COLORLIGHT SIGNALS

UNILENS displays all color indications thru ONE LENS

UNILENS
utilizes 75% of the lamp output compared to 30% used by present colorlight signals.

UNILENS features a more efficient SEALED BEAM LIGHT SOURCE

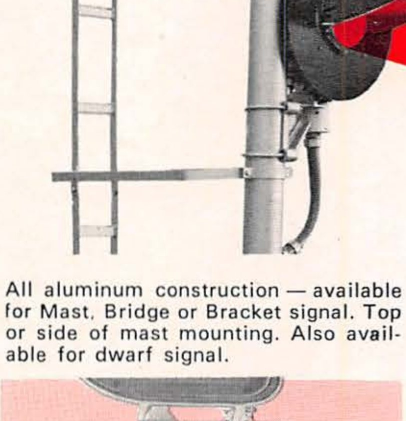
All aluminum construction — available for Mast, Bridge or Bracket signal. Top or side of mast mounting. Also available for dwarf signal.

BUT THAT'S JUST HALF THE STORY . . .

False proceed indications due to faulty or damaged mechanisms are things of the past because UNILENS has no moving parts . . . no mechanism . . . no need for repeating relays and associated circuitry!

UNILENS colorlight signals require no change in wiring or circuitry when replacing obsolete multi-lens colorlight signals . . . when replacing semaphores or searchlight type signals only minor circuit change is required.

RESULT: A better signal, yet costs less to buy, install, and maintain than any other type of wayside signal.



Interior view of light source and fibre optic system.

SEE THE UNILESS and other new RACO products Oct. 1-3 . . . Booths 61 and 62 . . . at the Annual AAR Communications & Signal Section Meeting.

MEMBER RPI RAILWAY PROGRESS INSTITUTE

RACO PRODUCTS ENGINEERED FOR LONG LIFE ®

Railroad Accessories Corporation

Main Office and Plant: 4650 MAIN STREET N.E., MINNEAPOLIS, MINN. 55421
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IN CANADA: Vale Enterprises, Ltd., 1120 Claire Crescent, Lachine, Quebec

Circle 1 on reader service card on page 78

Put your stations on the wagon.

Maintenance calls cost money, lots of it. Take water, for instance. By the time your crews make their rounds adding water to your communications batteries, you could be paying $40.00 a pint . . . or more.

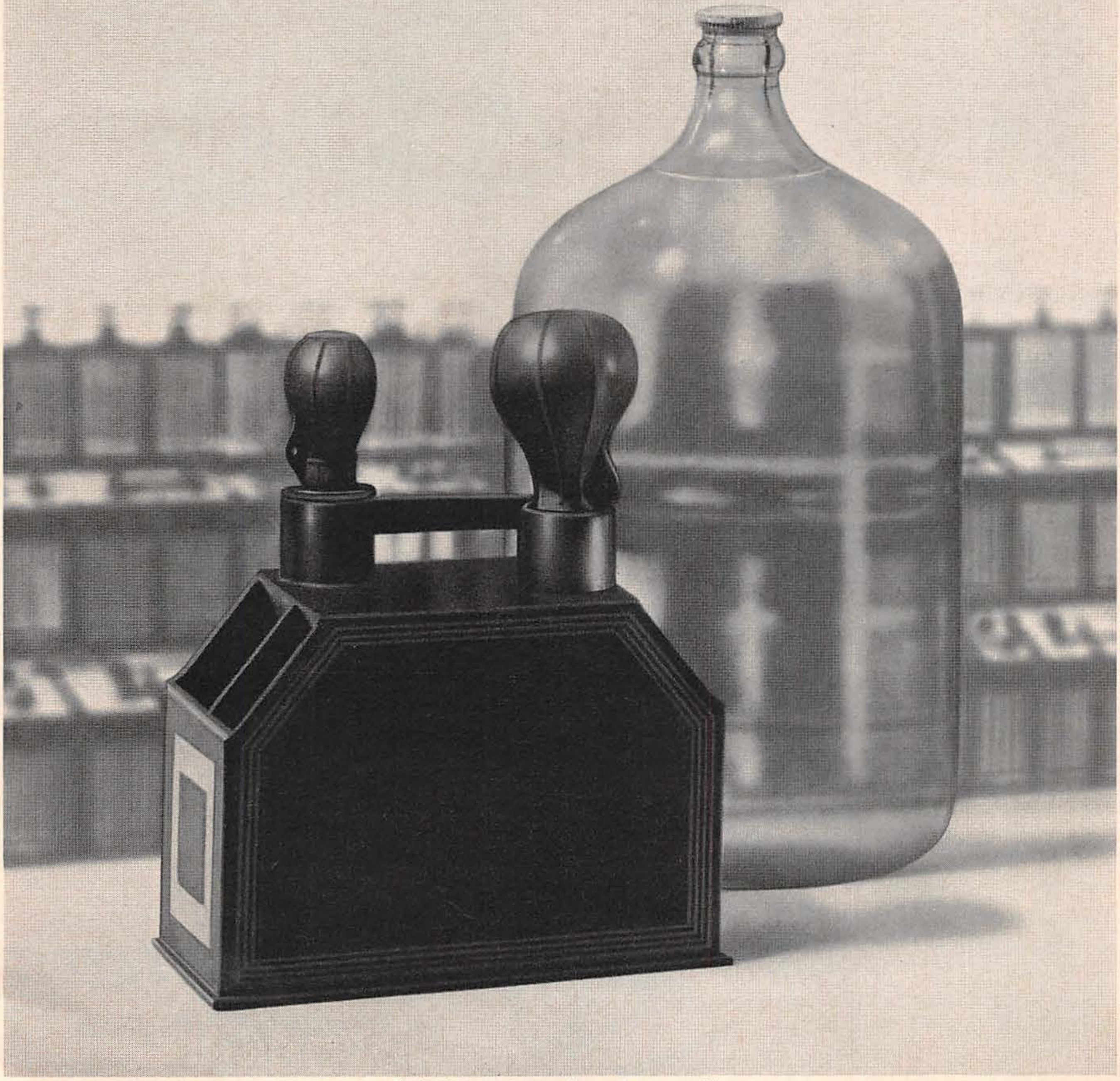
That's why economy-minded companies install C & D lead calcium batteries and make one battery maintenance call a year.

Their crews only have to add water once every three years, or so, as compared with 6 to 12 times each year for conventional antimony types.

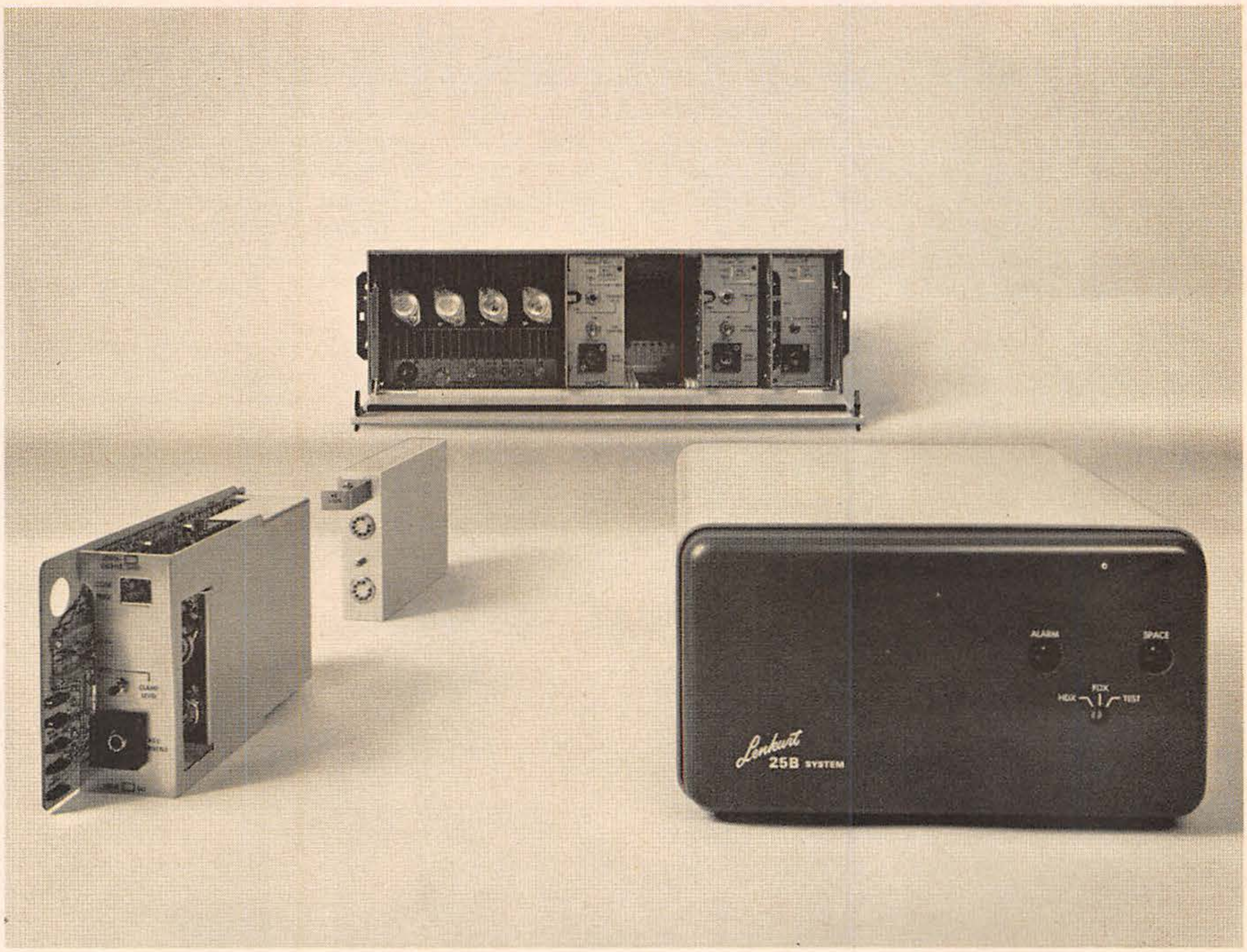
What's more, equalizing charges are eliminated. C & D lead calcium batteries never need one if kept on the proper float charge, but antimony types average one equalizing charge a month. Antimony batteries may also require a check charge at least 6 times a year. But there's never a check charge with C & D calcium types.

If you can't spare $40.00 for a pint of water, spare a few minutes to get the maintenance saving facts. Write to C & D Batteries, Conshohocken, Pa. 19428.

C&D BATTERIES
DIVISION OF **ELTRA** CORPORATION
Washington & Cherry Streets, Conshohocken, Pa. 19428



Circle 4 on reader service card on page 78



Introducing the versatile 25B Data Transmission System by Lenkurt: Adaptable to whatever mode your data's in.

The new 25B Data Transmission System is the economical way to handle computer, telegraph, and telemeter data – individually or in combination.

With the 25B, you get unmatched flexibility both in types of channels and in equipment arrangements. Plug-in filters give you a choice of five channel spacings and related data speeds – from 120 Hz for 75 b/s to 1020 Hz for 600 b/s. Compared to similar systems, you get about 20% more speed for a given channel spacing.

For single-channel operation, all you need is a pair of compact, self-contained modems working end-to-end. For multichannel applications, use two sets of terminal equipment. Or you can use terminal equipment to work into modems at several remote locations.

There are added benefits. Like three-frequency operation – ideal for on-hold-off applications. Like built-in test facilities. And many others.

Want more facts? Just call or write Lenkurt Electric Co., Inc., San Carlos, California.

LENKURT ELECTRIC
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS
GENERAL SYSTEM

Circle 5 on reader service card on page 78

September 1968
Vol. 61 No. 9

Railway Signaling & Communications

Railroads Keep Computers Busy 21
Track Circuit Has Pulse Modulation Control 32
How to Protect Against Electrical Surges 47
Communication & Signal Section Meeting Program 52
News Briefs 12
Data Sheets 155 and 156: Data Modems 38, 43
View from the Crossarm 50
Letters to the Editor 51
Railway Cybernetics 53
Product News 54
Feedback 64

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Editor's Corner

- Most new developments in the signaling field are evolutionary, not revolutionary. However, I believe that two achievements deserve mention as well as praise for the manufacturers who spent their own money and efforts to develop these new products. From the science of fibre optics comes Railroad Accessories Corp.'s colorlight signals. Similarly multicolor interlocking panel lights of Pulco Electronics Inc. use fibre optics. Both have the advantages of using so-called light pipes in which light can be transmitted along a fibre-glass tube to the point of usage. Thus various colored lamps can be so connected that their light output is directed through a single lens system. In the case of the signal, it is an economical and efficient departure from the conventional searchlight signal. For an interlocking panel, it provides multi-colors through a single indication lens, which requires less panel space than if separate indication spots were used.

Again, it should be remembered that manufacturers must make sufficient profits to have money available for research and development. Out of these profits come new products to make railroading more efficient.

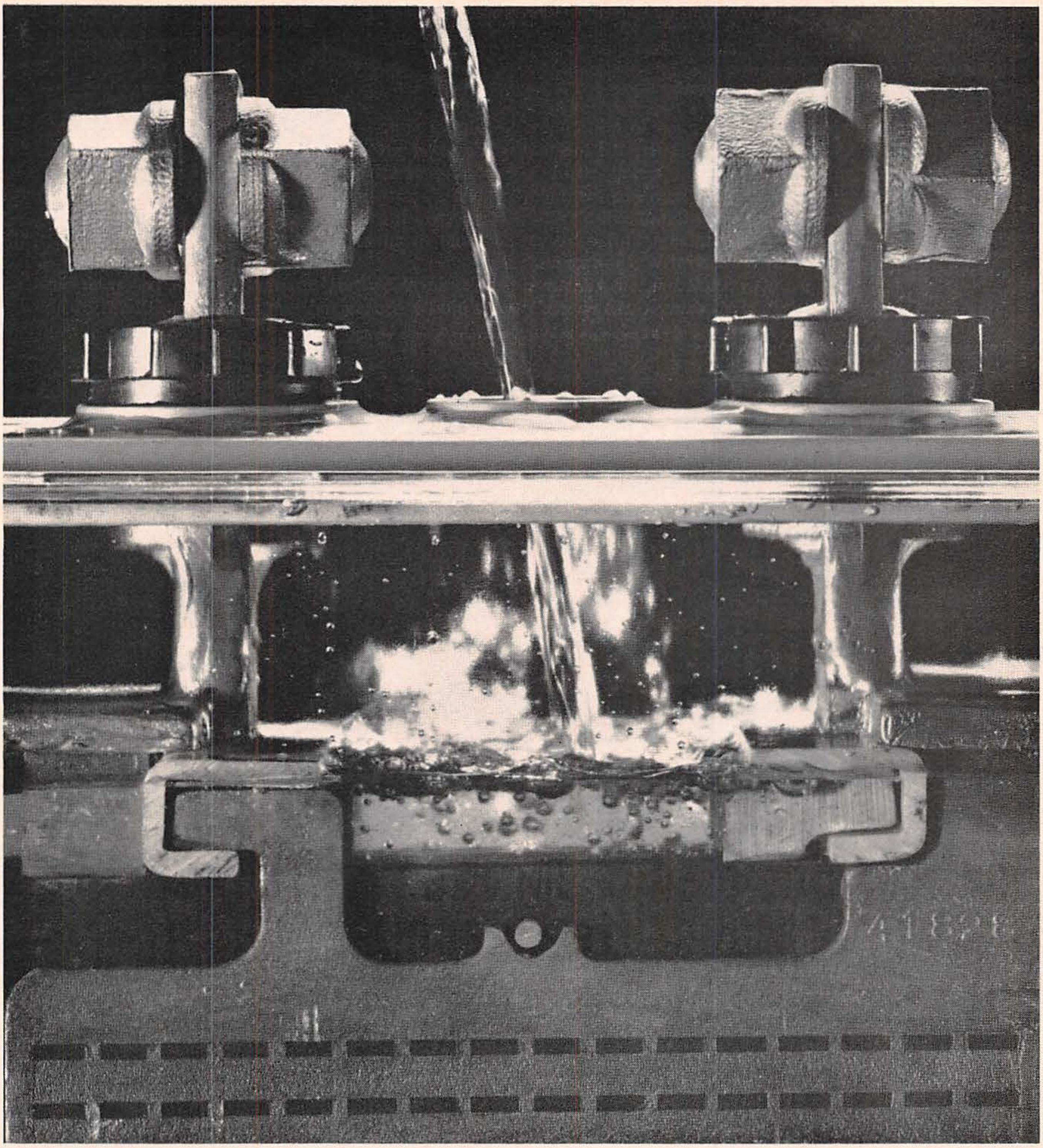
I believe that you will find this year's exhibits by the Railway Signal and Communications Suppliers Association at the Dallas meeting reflecting the progressive approach of manufacturers to new and more effective products.

- Again, I reluctantly announce that my associate editor is leaving. One would think that possibly the editor is impossible (stop cheering!). Elsworth Abbott will be moving to a rewarding and challenging job. At the moment I can't say where he is going, but I know that he will do a splendid job for his new employer.

It has been a most pleasant association with him on Railway Signaling & Communications. I will miss him, but will still see him from time to time as he will be here in Chicago. I know that he has been well-liked by you, our readers. His winning smile, cheerful attitude and penchant for doing a fine job made him a valuable associate. I wish him the best of success in his new venture.

- CORRECTION: The maintenance cost for highway crossing protection is $600 per year, reported H. A. Linderer, superintendent safety and rules, Frisco. This is the correct figure, not the $60 mentioned on page 23 of July 1968, RS&C. Our apologies to Mr. Linderer for this mistake.

Bob McKnight



We put more acid in our batteries so you'll get more power out.

We try not to overlook anything that will make Gould batteries for signalling and communications the best you can get. Designing our battery jar to hold extra acid (and lead) is one example. Our jar is slightly larger . . . and stronger, too. The extra acid we can get into it gives us longer periods of discharge. Simply, it results in more power—longer—per interruption.

A little thing, jar design? Perhaps. But we think it's attention to the "little" things that has earned Gould's reputation of being leaders in signalling and communications batteries.

Little things, too, like delivering the batteries and chargers you need when you need them.

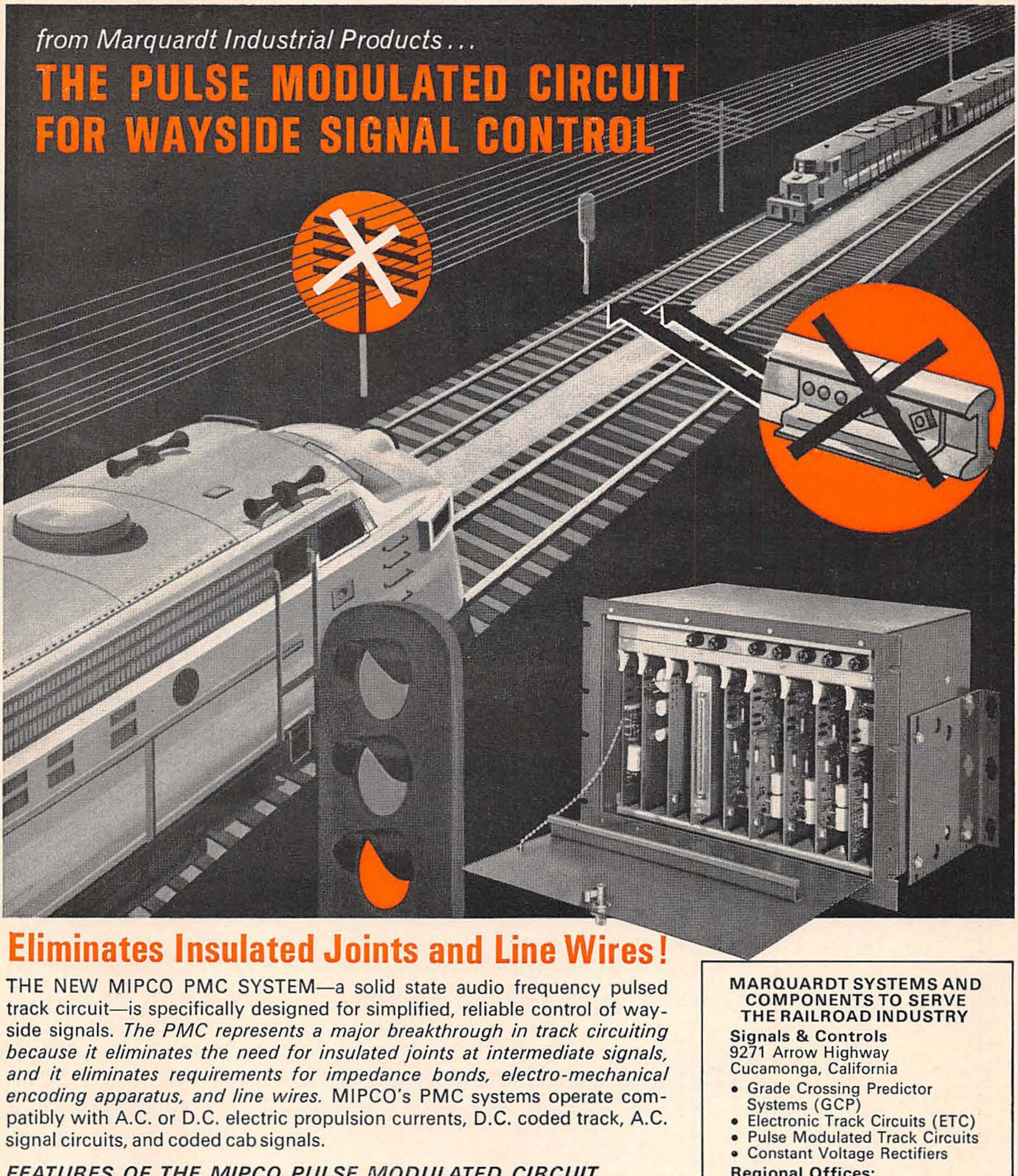
We'd like to tell you all about Gould stationary power systems for signalling and communications. Write *Gould-National Batteries, Inc., Ind. Battery Div., 467 Calhoun St., Trenton, N. J. 08607.*

GOULD NATIONAL
BATTERY POWER

Circle 6 on reader service card on page 78

from Marquardt Industrial Products . . .

THE PULSE MODULATED CIRCUIT FOR WAYSIDE SIGNAL CONTROL



Eliminates Insulated Joints and Line Wires!

THE NEW MIPCO PMC SYSTEM—a solid state audio frequency pulsed track circuit—is specifically designed for simplified, reliable control of wayside signals. *The PMC represents a major breakthrough in track circuiting because it eliminates the need for insulated joints at intermediate signals, and it eliminates requirements for impedance bonds, electro-mechanical encoding apparatus, and line wires.* MIPCO's PMC systems operate compatibly with A.C. or D.C. electric propulsion currents, D.C. coded track, A.C. signal circuits, and coded cab signals.

FEATURES OF THE MIPCO PULSE MODULATED CIRCUIT

- *Uniform operation in electrified and non-electrified territory!*
- *Eliminates most insulated joints, impedance bonds, and line wires!*
- *Lower installation and maintenance costs; plug-in circuit modules!*
- *Reliable fail-safe operation under extreme environmental conditions!*
- *Up to 11 carrier frequencies, each with up to 10 channels, available!*

For dependable wayside signal control, ask your MIPCO representative for complete details on the PMC system today.

MARQUARDT SYSTEMS AND COMPONENTS TO SERVE THE RAILROAD INDUSTRY

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MARQUARDT INDUSTRIAL PRODUCTS CO.

Circle 7 on reader service card on page 78

Next month you can see your way out of transient damages.

At least for the life of the solid-state products you are trying to protect . . . and more likely longer. It's true. You can truly protect the electronics along your entire line from voltage transients, current transients, direct lightning strikes, and overillumination. To learn how, stop at Joslyn's Booth 49 during the AAR Communications and Signal Section Meeting and Exhibit, October 1-3, Regency Room, Hotel Adolphus, Dallas. You'll get facts and figures you're not accustomed to, because they pertain to surge protection equipment that's beyond your spec requirements . . . but which will save you money!

JOSLYN ELECTRONIC SYSTEMS
Santa Barbara Research Park
P. O. Box 817
Goleta, California 93017
Tel. (805) 968-3551

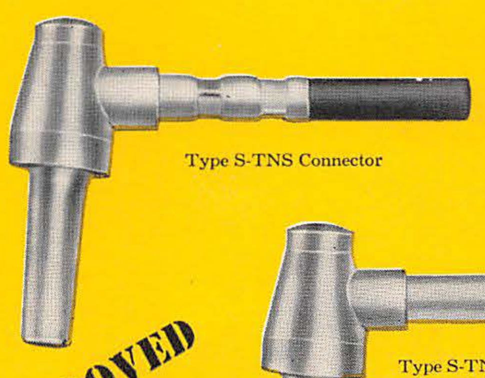
Circle 8 on reader service card on page 78

Improved track circuit connections with "Do-it-yourself" USS Tiger Brand S-8 Strand and Track Cable

With USS S-8 Strand and USS Track Cable plus the improved fittings illustrated, track connections are now easier to make in the field. Using the "J" groove of the popular 31-DJ Nicopress tool (illustrated), the cable or strand is quickly and positively locked into the fittings—with only two presses.

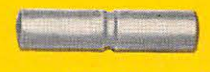
USS S-8 Strand is available bare in 250-foot coils and 2500-foot reels, and insulated in 100-foot coils and 1000-foot reels. USS Track Cable #9AWG Solid is available in 2000-foot reels. The fittings illustrated below, plus splicing and reducing sleeves for different wire sizes, are all available from United States Steel. If you prefer manufactured signal bonds and connectors, U. S. Steel maintains a complete stock of USS TIGERWELD Rail Bonds.

For more information, contact the United States Steel sales office nearest you, or United States Steel, P. O. Box 86, Pittsburgh, Pennsylvania 15230. Export Distributor: United States Steel International (New York), Inc., P. O. Box 75, New York 10008.



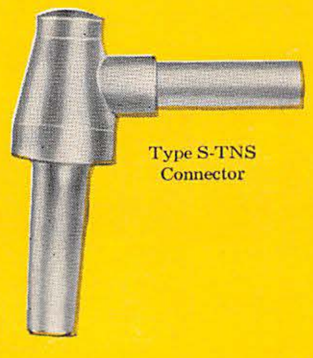
Type S-TNS Connector

USS Type S-8 Insulated Strand



Type 2314-J Sleeve $\frac{3}{16}$" to #9 AWG

USS Track Cable #9 AWG Solid



Type S-TNS Connector

USS Type S-8 Strand

Type 2412-J Terminal Lug, $\frac{3}{16}$" Strand

Type No. 31-DJ Nicopress Tool

USS, TIGERWELD, and TIGER BRAND are registered trademarks of United States Steel. NICOPRESS is a registered trademark of The National Telephone Supply Co.

USS United States Steel

The battery and ½

Now you can buy nickel-iron batteries directly from us.

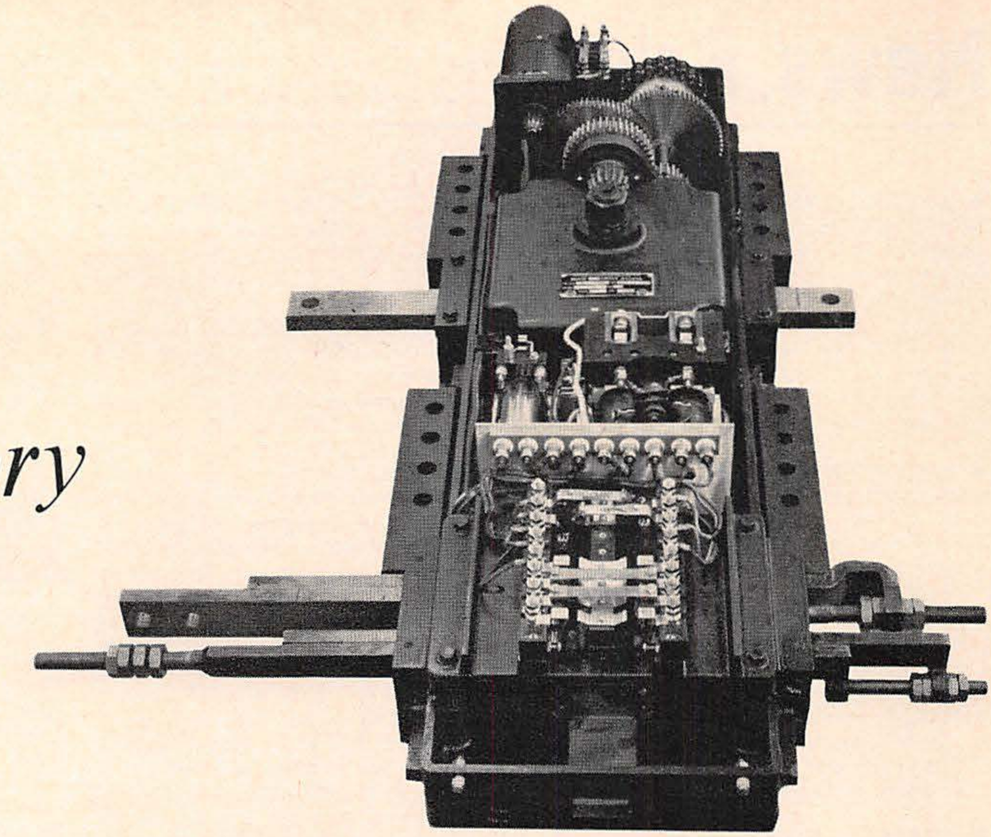
And get all the benefits of sales and service from the experts. From now on nickel-iron signal batteries will be sold by Exide Railroad Specialists. And, since we are the only maker of nickel-iron batteries, we've learned quite a bit about this type of packaged power during the last 50-plus years.

You already know the proven reliability of the nickel-iron battery in signal service. No battery can take the electrical abuse a nickel-iron battery can. Things like accidental shorting, over discharging, even reverse charging. And it's made entirely of steel. No battery lives as long as a nickel-iron battery.

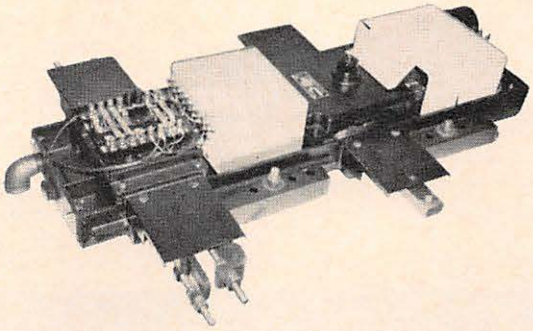
If you still don't know why we call our nickel-iron battery a "battery and ½" call your Exide Railroad Specialist. Or write: Industrial Group, ESB Incorporated, Box 5723, Philadelphia, Pa. 19120.

World leader in packaged power. ESB Exide®

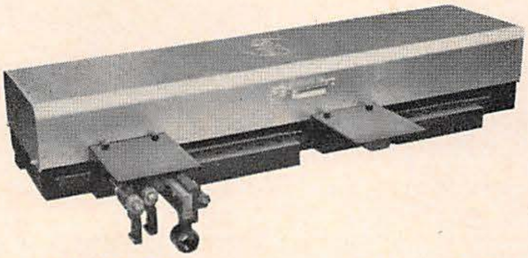
The Inside Story



on the GRS Model 55 Electric Switch Machine



Lock and detector rods are single, double-adjustable with renewable, one-piece, box-style wear plates.



The Model 55 can operate a single switch, a double-slip switch with a continuous front rod, or any type derail in mainline or rapid transit service.

Weighs only 520 pounds (other machines weigh up to half a ton). The motor, for example, weighs only 12½ pounds, is only 4 inches in diameter, yet turns out ½ hp.

Lubricates in seconds—only four gear faces and four sliding surfaces. No grease gun needed.

Major assemblies—point-detector, motor, main gear, intermediate gears—easily removed for inspection and/or replacement.

One-piece, deep-sided cover (aluminum for lightness and corrosion resistance) removes in seconds to fully expose internal assemblies.

The Model 55 can be used as a direct replacement for the Models 5C, 5E, and 5G machines. It also replaces the Model 5 rapid transit machine (with minor changes in layout). For the complete story, contact your GRS sales representative.

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3463

Circle 10 on reader service card on page 78

News Briefs

● AMERICAN TELEPHONE & TELEGRAPH CO. and Western Union Telegraph Co. have resumed negotiations for the acquisition of teletypewriter exchange service (TWX) by W.U. Bell System now has more than 40,000 subscribers to its TWX Service, and 1967 revenues amounted to $72 million. W.U.'s competing Telex service shows revenues of approximately $40 million annually.

● BROTHERHOOD OF RAILROAD SIGNALMEN'S Executive Council has ordered a strike vote of its 13,000 members. Such a request follows a breakdown in negotiations of the BofRS with the Joint Carriers' Conference Committee. Both sides have requested the National Mediation Board to intervene in the dispute. **C. J. Chamberlain,** president of BofRS, predicted that the signalmen would overwhelmingly vote for strike action to back up their demands for a wage increase of 25% over the next three years plus skilled differentials of 90 cents an hour.

● CANADIAN NATIONAL has awarded a $1.5 million contract to General Railway Signal Company to provide equipment for 115 miles of CTC for installation between Kingston and Clarke East, Ontario. The system 4000, a solid-state coding facility, will be used to link 21 remote field locations with the NX route type control console at Belleville, Ontario. Also included in the contract will be 435 type SA-1 searchlight signals, 88 model 5F switch machines and 29 model 9B electric switch locks.

Also CN also ordered type J CTC equipment from General Railway Signal Co. for control of 7 locations between Gahier and Pointe aux Trembles, Quebec. The control console will be at Montreal, Quebec, yard.

● CHICAGO TRANSIT AUTHORITY has awarded a contract to Motorola Communications & Electronics, Inc. in the amount of $1,339,350 to provide a bus monitoring system for 500 CTA buses. The transit control system which applies computer technology and advanced radio communications techniques to provide centralized information and control is being made possible for CTA through a demonstration grant from the U.S. Department of Transportation. The cost of the project is $2,000,000, with $1,549,000 being provided by the U.S. Department of Transportation and the balance, $451,000, by CTA.

A four-year time period has been set up for the demonstration. Delivery is to start in eight months and to be completed in 14 months. The balance of the time will be used for testing the system. The demonstration grant for 500 buses will permit almost all buses on the late evening and early morning shift to be fully equipped.

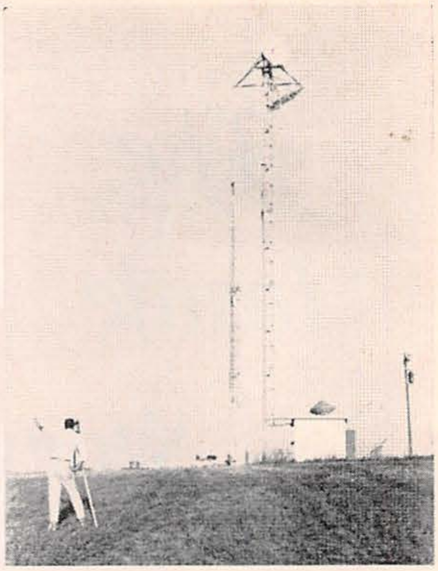
With this bus monitoring system, basic information or identification, location, and alarm status of each bus is automatically provided on a continuous basis at a centralized control point. This information will be used to provide schedule adherence data, operational status, and alarm conditions. The system also will provide direct two-way voice communications with any bus on an individual basis.

The essential elements of the bus monitoring system are:

A control center, including a computer and its peripheral equipment.

Electronic wayside equipment located along bus routes, and

Two-way radio and electronic equipment aboard buses.



Union Pacific's system wide microwave network is now about 90% complete. Typical of the guyed towers is this one at Maple Hill, northwest of Fremont, Neb., which was built and erected by Andrew Tower, Inc. Other towers range in height from 10 ft to more than 260 ft and they are designed for wind loads ranging from 85 to 100 mph, with 1/2" to 2" of ice loading during storms.

The bus monitoring system takes advantage of the fact that every bus is assigned a run number. It is this run number which makes each bus unique and enables the computer to rapidly interrogate and evaluate each individual run. Bus locations are pinpointed along the routes. The location information received on each bus is then automatically compared against a computer-stored schedule. This accurate evaluation of the route progress of each bus and the computer comparison is used as a basis for informing the dispatcher of corrective action required on his part.

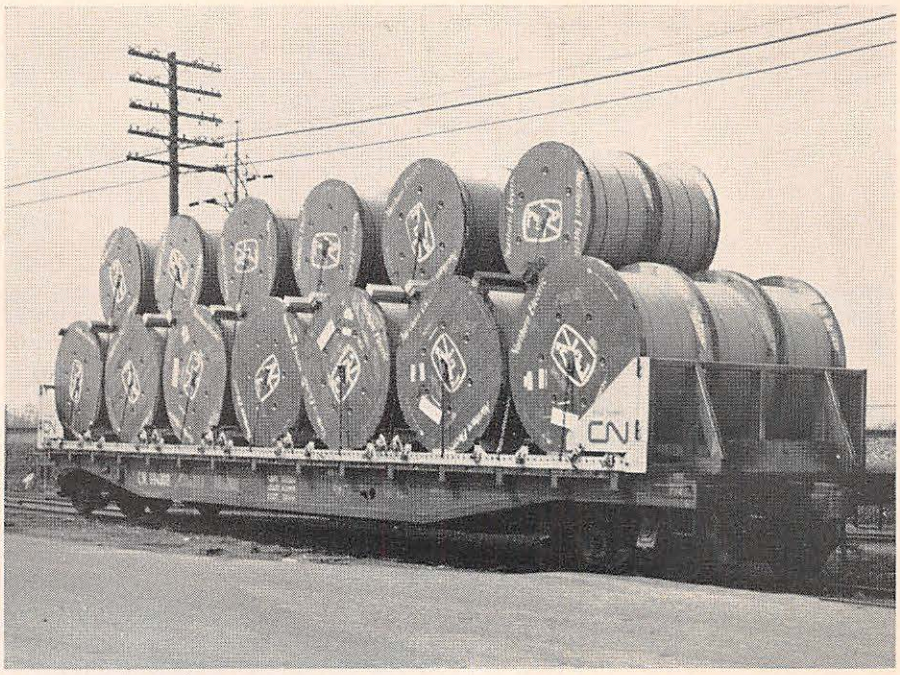
When a position report is received, the computer evaluates the reported data against its programmed schedule. If the location of the bus conforms to schedule,

...switch heater

Switch point and tie rods free and clear of ice and snow.

Heat directed along rail and down between ties.

Will not smother or blow out due to drifting snow and high winds.



Canadian National has cut shipper loading costs by 80% and unloading costs by 50% with its new specially designed reel cars. They were made to handle cable reels. These cars can carry loads previously requiring 2 box cars and accommodate any sized reel up to 126" in diameter. The cars can be loaded and unloaded with either a fork lift or an overhead crane and reels can be tiered. Each car is equipped with adjustable chocks which extend across the width of the car and support the reels during transit. They can be positioned manually in a matter of minutes. The reel car has been designed for loads ranging from 60,000 to 165,000 lb.

no action is taken. If the bus is off schedule, all pertinent data on that bus is sent to the dispatcher's communication control center where a visual display indicates the bus run number, the route, direction of travel, the point in the route where it is off schedule and the time deviation. Off schedule indications are also recorded on a printer for permanent record. With the two-way radio, the dispatcher can instantly instruct operators as to what corrective action to take to bring the schedules back to normal.

Using tone-coded, data transmission equipment, the bus picks up signals from low power transmitters (electronic "signposts") which are placed at selected intervals along each route. When the bus receives a signal from a transmitter, the data equipment in the bus enters the electronic "signpost" number and starts an elapsed time indicator which counts, in 12-second intervals, the time since the last position signal was received. When the bus is interrogated by the computer over the data communications channel, it releases this information, thus telling the computer its location on the route. The computer than automatically compares it against the schedule for that bus.

An integral part of the bus monitoring system is the emergency alarm, which enables help to be summoned by the operator with no overt action on his part, such as picking up a microphone, which could place him in jeopardy. However, this signal is visually seen at the control center.

In addition to location and alarm capability, the system includes normal two-way voice communication. The dispatcher may call and communicate with one or more buses on a selective basis and the operator may originate calls also.

- DETROIT & TOLEDO SHORE LINE has received approval from the Federal Railroad Administration of DOT to install a traffic control system between Lang and Gibralter, Mich., approximately 29 miles.

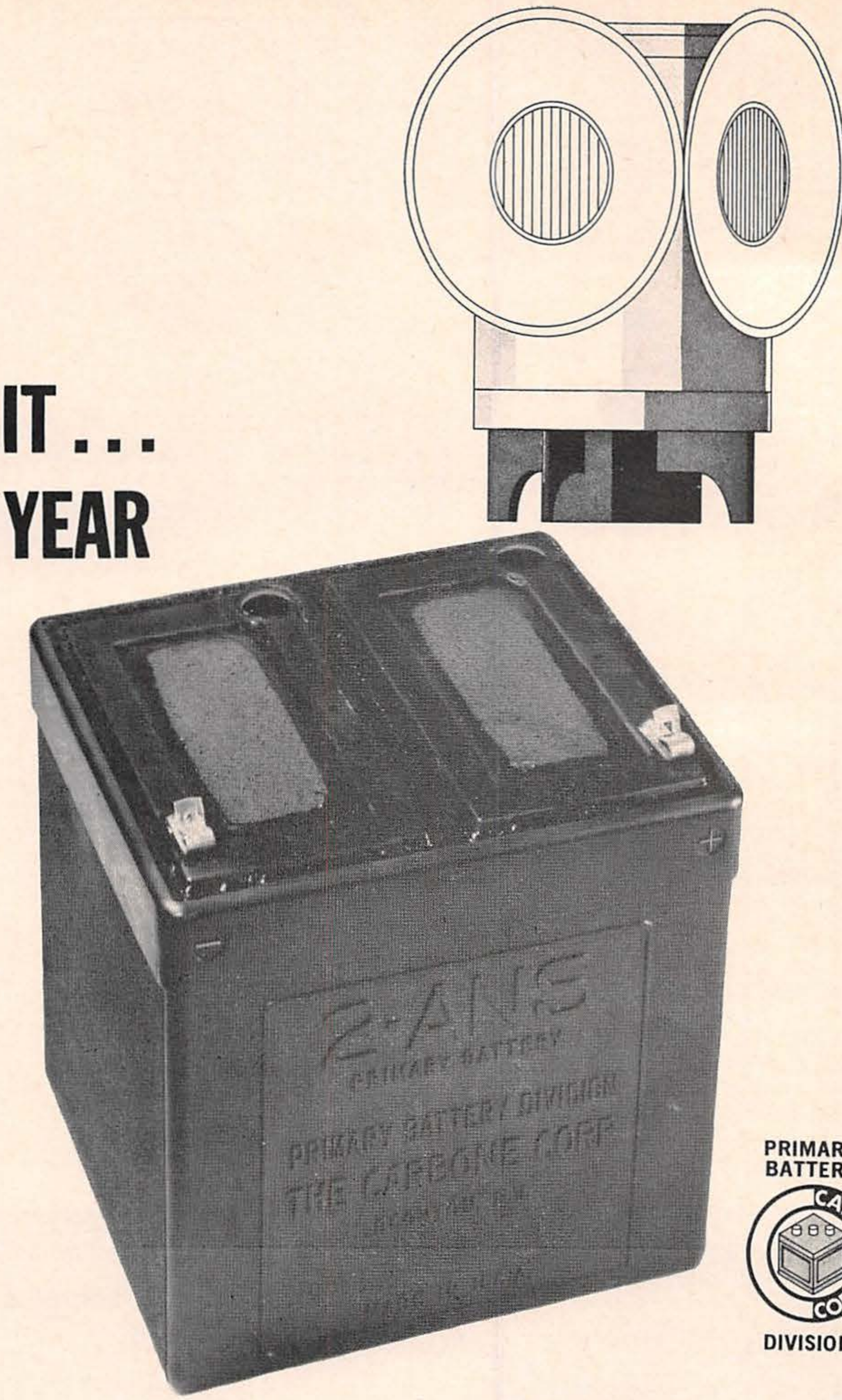
- ELECTRONIC INDUSTRIES ASSOCIATION has formed a transportation committee charged with developing association policy relating to the application of electronics to all forms of land, sea and air transportation.

- FEDERAL COMMUNICATIONS COMMISSION has decided to institute a new overall private line rate case which would combine the existing separate Telpak docket, the now-suspended private line teletypewriter station equipment changes, and all other interstate non-program services of AT&T. FCC has suspended the private line teletypewriter station rates for three months to Nov. 1. Although the commission has decided to institute a new major interstate rate investigation, it has deferred action on this until further notice. Informed sources indicate that the pending teletypewriter station rate will take effect Nov. 1.

(Please turn to page 68)

VAPOR'S NEW
SNO
GARD
T.M.
GAS SWITCH HEATER
Circle 11 on reader service card on page 78

PLACE IT . . .
AND FORGET IT . . .
FOR UP TO A YEAR



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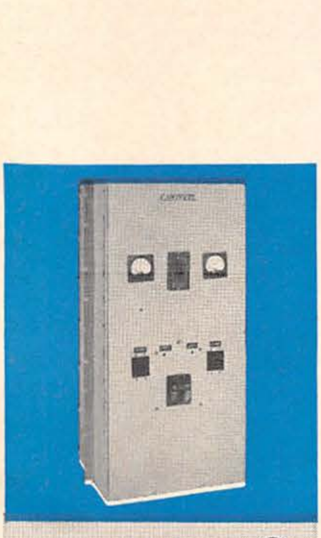
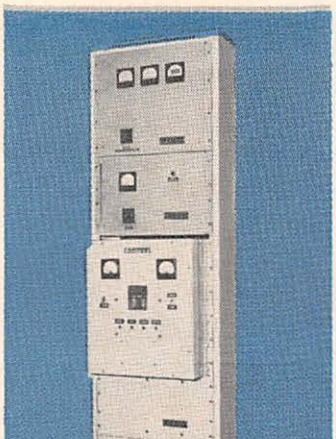

Constant Potential Battery Charger


Static SCR Inverter shown in Standby Power System

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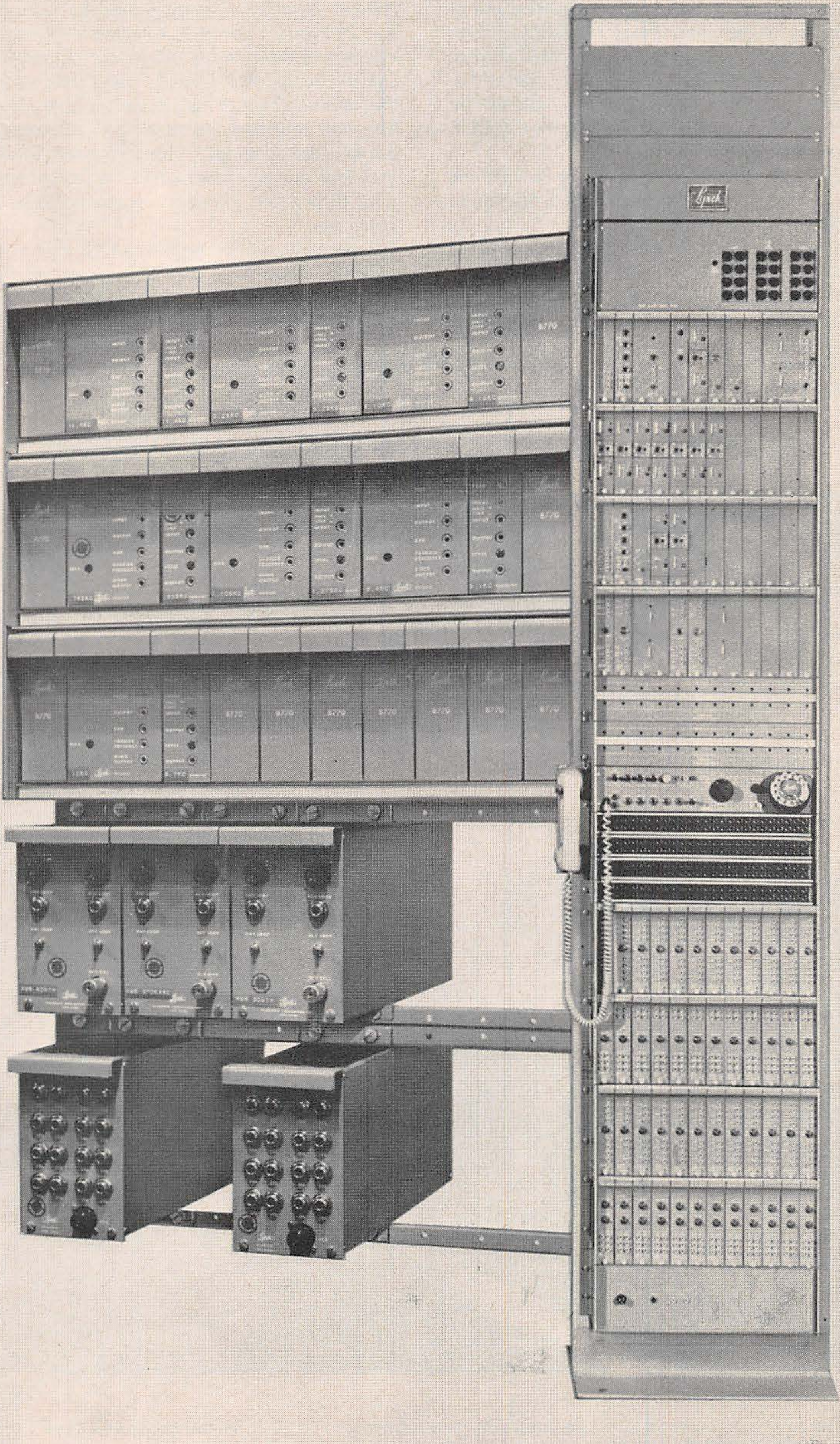

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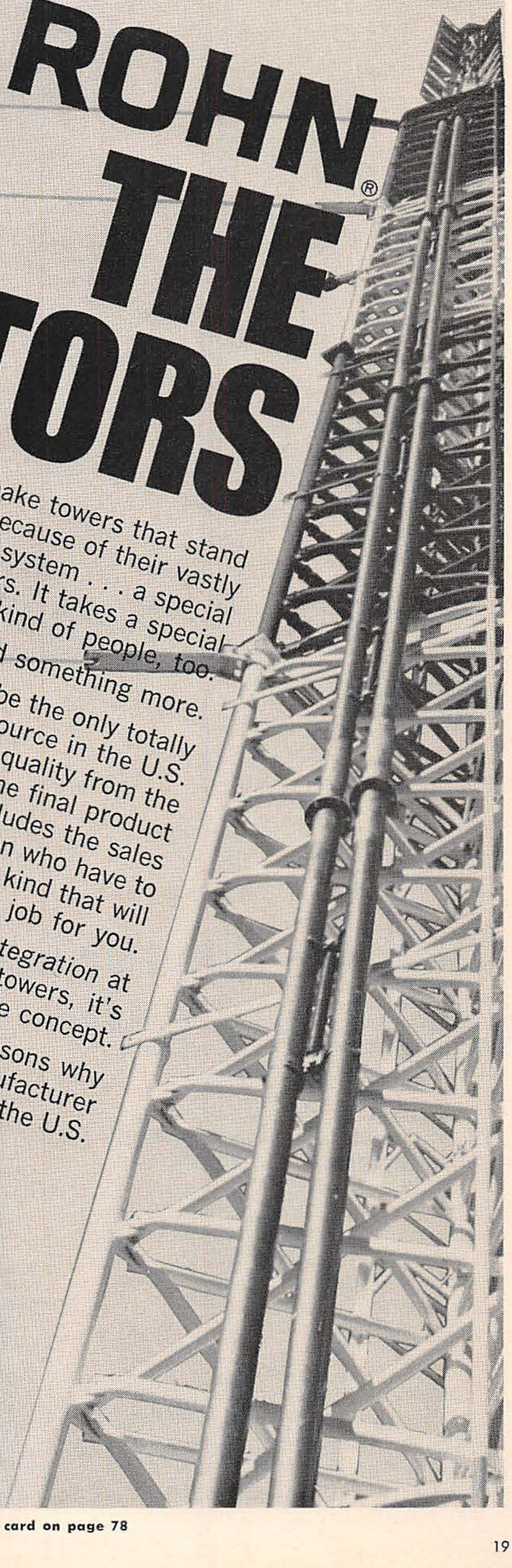

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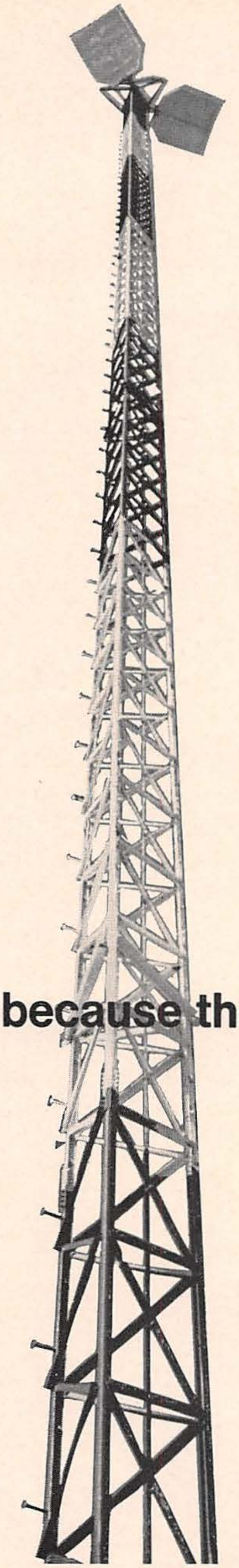

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Railroads keep computers busy

There's plenty to keep communications engineers busy these days. A recent survey of railroads using computerized equipment for car reporting and message switching supports that view. From the *Railway Signaling & Communications* survey came reports that of 59 Class I railroads in the U.S. and Canada, some 49 with but four exceptions are installing computerized equipment to provide mechanized car reporting systems. They range from Union Pacific's COIN and Reading's TRACE to Alton & Southern which does the paper work on a computer, but handles inquiries via telephone.

Of the four roads that do not use computer-generated car reporting information, two roads handle such a small volume of cars that they can be traced using manual methods. One railroad works with a captive fleet, which makes the car tracing job relatively simple. The third road is a bridge line which receives teletype consists from its connections covering about 95% of the cars handled. All four roads answer inquiries via telephone from their traffic offices.

No matter how the information from this survey is analyzed, one fact stands out. It is that railroads are computerizing their car reporting function, not only for their own use (better car utilization), but to give shippers more prompt information concerning car movements.

All roads report that shippers may place car-movement inquiries via telephone to their sales or traffic offices. Additionally, most roads provide telephone inquiry service at their headquarters or car location center.

Several railroads not listed in the tables reported that they are in the process of planning, installing or implementing computerized car reporting systems. So as not to mislead the reader, only those roads are shown in the table that specifically reported that they have the services available that are outlined in the tables.

Belt Railway of Chicago is typical of many roads that is now in the process of programming an IBM 360 computer for car reporting and tracing functions, which will be operational by the first quarter of 1969. Presently, BRC maintains a car service bureau at Clearing in Chicago which provides a car tracing service for shippers by telephone and Western Union's Telex. They handle about 150 car service inquiries daily.

An interesting reply was received from the Long Island, which proved to be an outstanding exception. LI reports that better than 50% of its freight traffic is concentrated in a 20 to 25 mile area. The time lag between receiving

What plans railroads have for ACI

Railroad	Direct input to Computer	Facility and Speed
A&S	Possibly	83B2 polled by IBM 360 with 100 wpm Teletype
AT&SF	Yes	100 wpm to regional computers for editing, then at 1200 bits/sec to central computer
A&WP Ga, WofA	No	Card input daily
B&M	Yes	Not yet determined
CP	Yes	75 wpm Teletype
C&O/B&O	To field computers	—
CB&Q	Eventually	100 wpm Teletype
CMStP&P	Yes	100 wpm Teletype
D&H	Yes	—
D&RGW	Yes	100 wpm Teletype
DT&I	Yes	1 Sylvania ACI scanner transmits at 1800 baud over Bell System voice channel 3 Sylvania scanners transmit at 600 baud over Lenkurt 26C data set. All to TCS-50 computer
DM&IR	Yes	ACI scanners 150 baud lines
GN	Yes	Not determined
IC	Yes	IBM 1050
KCS	Yes	Over microwave at 2400 bits/sec
L&N	Now on test	Sylvania scanner, variable speeds
MP	Yes	Not available
PC	Yes	Sylvania scanners 100 wpm Teletype
RDG	Yes	Not yet determined
RF&P	Yes	IBM 1800
StL-SF	Yes	Not yet planned
SOU	Yes	Under study

and delivery is normally so short that cars are tendered for delivery before the records are available at the main office in Jamaica, N.Y.

Any car received by 6 p.m. at its Long Island City, N.Y. float bridges (Sunday through Thursday) will be tendered for delivery the following day. Cars received Friday will be delivered Monday. So here is a case where the car is delivered to the receiver, often well before the road could report its delivery from the paper work.

Missouri-Kansas-Texas is typical of some roads that reported they are deep in the work of planning, installing and programming for car control systems. Meanwhile, MKT for example, provides inquiry service through its traffic offices and also telephones to certain shippers about car location information. MKT expects to have a computerized car reporting system initially in service by the end of this year.

Several railroads indicated that they send reports regularly, often on a scheduled basis, to shippers concerning car movements. Detroit, Toledo & Ironton, for example, reports car movements to Ford Motor Co. and Campbell Soup Co. Milwaukee Road reports car movements directly to 85 shippers via Telex and AT&T's TWX on a daily basis.

The Tels-Car information report (a standard reporting form for car movements) is used by many roads. Soo Line, for example, supplies Tels-Car information to 24 shippers via Telex each morning.

A computer print-out is fine, but the large listings of car moves sometimes makes it difficult to quickly locate a particular car. A solution to the quick look-up is the use of visual displays, such as cathode ray tubes or video displays, similar to a TV picture tube. Chicago & North Western, Milwaukee Road and Penn Central, for example, provide trace clerks with such video display equipment.

While a caller is still on the telephone, the clerk presses numbers and letters on a keyboard for the car's initials and number. Almost instantaneously, the last move of the car is displayed on his CRT screen.

Regional sales offices of the C&NW are equipped with visual display units (CRT type) which are tied in with the road's RCA Spectra 70 computer in Chicago. Each office can query the computer direct and the reply is flashed back in visual display on the CRT.

"This computer network allows a level of customer service where we are able to do in a matter of a few seconds what used to take hours," reports John J. Kane, C&NW, vice-president sales and marketing.

Milwaukee Road's tracing center (Carscope office in Chicago) uses IBM 2260 visual display units that can access an IBM 360/30 computer that contains some 100,000 car records. Reports from 72 yards and 232 interchange points feed into the computer continuously. The car file is updated hourly.

Penn Central during 1968-1969 will be installing equipment which will provide a vocal response to a digital input to the computer requesting the latest movement information about a car.

Such a voice answer to a pushbutton inquiry is very much indicative of the trends in computerized car reporting that are developing. Such advanced techniques are resulting from the use of third generation computers. Many railroads reported plans to expand their data processing capability in the car movement field by installing third generation computers. Key to such efforts, is the new generation's ability to compute faster, contain greater memories and to do multi-processing simultaneously.

Indicative of this trend is the fact that 20 railroads reported that they have message switching computers in service or about to be installed. Several other railroads will have such computer capability available in 1969.

The table listing message switching computer capability indicates that such devices do more than merely switch messages. Canadian National, for example, handles airline and railway reservations on its three Collins Radio computers. Also, a considerable portion of CN Telecommunications message traffic is commercial in nature (CN and CP are the Western Union of Canada).

As might be expected, these message switching computers operate 24 hours daily, 7 days each week, the year around. Most railroads have duplicate facilities so that one processor is always on-line. Many roads use the back-up or standby computer for batch processing. However, arrangements are such that it can instantaneously take over from the main computer.

GOOD DATA BASE

Railroads have the facilities and equipment for mechanized or computerized car reporting systems. Also, they are establishing a good data base for such systems.

The trend is for input to the computer as events occur, such as a train arrives at or leaves a yard, cars are delivered or received in interchange, cars are pulled or spotted at shippers' or receivers' docks, at rip tracks, etc. Also, most roads indicated that they are updating their car files on a continuous basis. Thus with the development of more advanced inquiry techniques, and the increased capability with third generation computers for random inquiry, accurate car movement information is becoming available.

The big payoff for the customer (shipper and receiver) is that the railroads are able to provide accurate car movement information when the shipper or receiver demands it. To keep from flooding customers with tons of statistics and paper on car moves, several roads are moving into the area of exception reporting. Thus cars meeting schedules or promised delivery dates are reported once to provide that date to the customer. Thereafter, they are only reported when they go off the schedule.

Typical of the type of car tracing for shippers is that furnished by the Louisville & Nashville. L&N provides direct car location inquiry, daily fleet tracing and auxiliary fleet tracing.

Direct inquiry is initiated by the customer using any authorized Telex or TWX terminal anywhere in the U.S. Inquiry is made by means of punched paper tape. Location information can be obtained on as many as 40 cars in a single inquiry. There is no limit to the number of inquiries that can be made by a shipper in a day.

Fleet tracing is computer generated on a once-per-day basis. By pre-arrangement, a list of all cars owned or leased by a shipper is stored in the computer. The computer automatically generates a report to the shipper indicating current location (and other pertinent data) of all of his cars currently on the L&N.

Auxiliary tracing is like fleet tracing in every respect except that surveillance is on a limited number of cars selected by the shipper. Such surveillance continues for a fixed number of days only, or until a pre-determined event occurs.

Each of the three methods, reports an L&N spokesman, provides essential information to the shipper for such purposes as (1) inventory control, (2) production control and scheduling, (3) customer service and (4) utilization of owned and leased freight cars.

An important feature turned up by this survey is that it is an exception for traffic or railroad sales offices to receive jumbo computer print outs of all moves on all cars. Most railroads are making sorts based upon cars destined to or originating in traffic or sales office's territories.

C&O/B&O has gone one step further in a pilot project in quality control. This project provides three commercial service reports that cover over-all, dock-to-dock performance, interline performance and salesman's performance. The salesman's report is aimed at helping him know ahead of time

Car reporting systems require extensive communications

Railroad	Input transmission and speed	Method of car movement data transmission	
		on-line offices	off-line offices
A&S	Punched cards, 300 cards/min	—	Teletype
AT&SF	197 sta 60 wpm Teletype 10 sta 7 cards/min 1 sta IBM 1050 150 wpm	Teletype Paper tape Telephone	Teletype Paper tape Telephone Telex, TWX
A&WP Ga, WofA	75 wpm Teletype	—	To 1912 card punch
BAR	—	Telephone	Telephone Teletype
B&M	100 wpm Teletype Fax 15 min/wheel report	Telephone Mail TWX	Telex Air Mail
CN	Punched card	Teletype	Magnetic tape
CP	75 wpm Teletype 7 cards/min	Teletype Telex	Teletype Telex 1401s with 1009 data set
CNJ	IBM 1050, 930 chars/min	IBM 1050	IBM 1050
C&O/B&O	100 wpm Teletype	Teletype	Teletype
C&NW	IBM 1050, 14.8 chars/sec	—	Teletype
CB&Q	100 wpm Teletype	Teletype	—
CMStP&P	100 wpm Teletype 250 cards/min Telephone recording	Teletype Punched card Telex, TWX Telephone	Teletype Paper tape Telex, TWX WU 115
CRI&P	60 wpm Teletype 1050, 148 wpm	Teletype Telephone IBM 1050	Teletype Telephone Telex
D&H	1050, punched card at 14.8 chars/sec	IBM 1050	Teletype
D&RGW	100 wpm Teletype 100 cards/min	Teletype Telephone Paper tape	Teletype Paper tape Telephone Telex, TWX
DM&IR	1050 at 14.8 chars/sec ACI scanners at 14.8 chars/sec	Punched card IBM 1050	Telephone
EL	100 wpm Teletype	Teletype Telephone IBM 1050	Telephone TWX
FEC	Punched cards at 500 cards/min	—	Telex
GN	100 wpm Teletype 1050 at 150 wpm Univac DCT-2000 at 180 cards/min	Teletype Punched card Paper tape IBM 1050 Telex, TWX Telephone 1004 unit	Teletype Paper tape Telex, TWX Telephone
IC	75 and 100 wpm paper tape Teletype 1050 card 150 wpm	Teletype Magnetic tape IBM 1050	—
KCS	IBM 1050 at 150 wpm	IBM 1050	Telex, TWX
L&N	1000 cards/min IBM 1050 at 150 wpm IBM 2260	Punched card Telex, TWX IBM 2260 IBM 1050	IBM 1050 Telex, TWX
MP	13 sta at 60 wpm Teletype 20 sta at 60 cards/min 5 sta, 1050, 148 wpm 5 sta, Telex, 50 wpm 8 IBM 2260 2 IBM 2740	Teletype Punched card Paper tape IBM 1050 Telex Telecopter	Teletype Paper tape IBM 1050 Telex Telephone Mail
N&W	IBM 1050 at 8 cards/min IBM 2740	Punched card IBM 1050 IBM 2740	Teletype Telex IBM 7702
NP	60 wpm Teletype IBM 1050 Nyematic recorder	—	Teletype Telex Telephone
PGE	Teletype IBM 1050 Mail	—	Teletype Punched card Paper tape IBM 1050 Telephone
PC	100 wpm Teletype	Teletype TWX	TWX
RDG	21 sta IBM 1050 at 150 wpm	IBM 1050 Mail	Punched card Telephone Mail
RF&P	3 sta IBM 1050 at 80 wpm	—	IBM 1050
StL-SF	60 and 100 wpm Teletype	Teletype IBM 1050	Telex
SCL	IBM 1050 at 560 chars/min	IBM 1050	
SOO	100 wpm Teletype 1050 at 180 wpm	Teletype Chicago only	Air Mail
SOU	IBM 1050 at 60 wpm Facsimile (LDX) 6 sec/waybill	Telex, TWX Telephone	Telex, TWX Telephone
SP	60 and 100 wpm Teletype	Teletype Paper tape IBM 1050 Telex, TWX Telephone	Teletype Telex, TWX Mail
UP	10 cards/min 1050 at 130 wpm	Teletype Punched card Paper tape IBM 1050	Teletype
WP	75 wpm Teletype	Teletype Telephone	Teletype

when his road is failing in service so that a shipper transfer may be imminent.

Measurement of overhead dock-to-dock service is based on data from interchange reports. A computer chooses interchange receipt records and interchanged deliveries at route terminations. Once a week the information moves from magnetic tape to punched cards which are processed to match interchange receipts with interchange deliveries by car initial and number. The number of elapsed hours from receipt to delivery is calculated. This time is compared with a previously computed standard time for handling this specific movement. The comparison reveals whether a car is within standard, beyond standard or the extent to which it is beyond standard. Here again, information developed from the car reporting system provides meaningful performance criteria for the railroad.

Although shippers were not included in this car reporting survey, many large users of rail service have their own computerized car reporting systems. Ford Motor Co. and Union Carbide Corp., to name two typically large rail users, have their own computerized car location systems for better car utilization and production scheduling. UC uses its system to measure the performance of carriers and routes through exception reporting.

Obviously not wishing to be quoted, railroad men have admitted that such car reporting systems as have been set up by shippers have spurred railroads into greater activity in this area.

Automatic car identification labels are appearing on more cars every day. That Jan. 1, 1970 date for all cars to be labeled for interchange purposes is not far off. Results from this survey reveal that a good many railroads are planning for implementing ACI beyond the mere labeling of freight cars, locomotives and cabooses.

Santa Fe is planning to provide direct input from ACI scanners to regional computers using 100 wpm teletype. These regional computers will edit the information and transmit to a central computer at the rate of 1200 bits per second.

Recently added to the ranks of ACI users is the Detroit, Toledo & Ironton which has four scanners covering the approaches and the hump at its Flat Rock classification yard. ACI is providing DT&I with an inventory of cars entering and leaving the yard. This with the date-time data generated gives a measure of yard performance.

In another area of future operations, seventeen railroads reported that they are planning for active participation in the AAR's TRAIN project. While pres-

Waybill data interchanged via circuits

Railroad	Interchange via circuits to yard offices or computer	Facility	Plans to Interchange Data
AT&SF	Yes	IBM 1050 at 134.5 band	Will expand
B&M	Yes	100 wpm teletype several times daily	—
CN	No	—	Yes
CNJ	Yes	IBM 1050 when moves made	Yes
C&O/B&O	Yes	100 wpm teletype	Yes
C&NW	Yes	066 transceiver 10 cards/min, daily	No
CB&Q	Yes	Teletype and 1050 with each train	Yes
CMStP&P	Yes	100 wpm teletype certain trains	Yes
CRI&P	Yes	1050 at 148 wpm daily prior to interchange	—
D&H	No	—	Yes
D&RGW	Yes	75 wpm teletype	Yes
EL	No	—	Yes
GN	Yes	75 wpm teletype 1050 at 150 wpm as occurs	Not until get AAR Standard
IC	Yes	100 wpm teletype 1050 at 150 wpm as occurs	—
L&N	Yes	1050 at 150 wpm 60 wpm teletype when occurs	Yes
MP	Yes	60 wpm teletype intermittent	Yes
PGE	No	—	Yes
PC	Yes	100 wpm teletype as train moves	Yes
RDG	Yes	IBM 1912 at 150 wpm random frequency	Yes
RF&P	Yes	IBM 1050 at 80 wpm 100 wpm teletype when trains dispatched or cars interchanged	—
SOO	Yes	75 wpm teletype to one road's computer for traffic use	No
SOU	No	—	Negotiate reciprocal arrangements
SP	Yes	100 wpm teletype via microwave 4 times daily	Possibly
UP	Yes	IBM 1050 at 10 cards/min as needed	Not decided
WP	Yes	75 wpm teletype various times	Yes

ent indications are that 750 wpm paper tape transmission is to be used for sending interchange data to the AAR's computer center in Washington, other speeds and methods of transmission are being considered by individual roads. Canadian Pacific and Soo Line, for example, would like to use 100 wpm teletype. On the other hand, Great Northern indicates a preference for transmission from its computer at 2400 bits per second. L&N would transmit to the TRAIN computer on a real-time basis via punched card or paper tape at high or low speed. Penn Central chooses to use magnetic tape sent daily by mail, whereas Reading would transmit punched cards via IBM 1050 equipment.

Several railroads reported that they would like to receive daily reports from the TRAIN computer, some several times daily. Other roads said that they would like reports as required, not necessarily on a regular schedule.

Twenty railroads reported that they now interchange car movement data with other railroads via direct circuits to their yard offices or computer center. Most roads indicated that such data interchange takes place when the moves are made or just prior to delivery of the interchange.

Most such information exchange is accomplished using 75 or 100 wpm teletype and IBM 1050 units. CP and Soo exchange latest car movement information each day via 75 wpm teletype between data centers for traffic department use.

Certainly this survey shows that the railroads are not standing still. They are deeply committed to computerized car reporting systems. And they are not content to stop at this one usage only. These computerized systems will also be used to measure service performance. This appears to be the really big benefit from computerized car reporting systems. It's a big benefit for both the railroad and the customer.

Message switching computers are the telephone exchanges of a data flow network. MSCs handle administrative messages, train consists, and just about any written message. MSCs are on-line, real-time devices. Most roads have duplicate machines for backup, or can use a batch processor in emergency as a message switcher. The big payoff of MSCs is the ability to get current date (not history) to the right persons in time for them to make intelligent decisions based upon facts.

Second and third generation computers have added a new dimension to paper flow in railroading. This new dimension is an outgrowth of earlier computer usage. It was really quite a logical step to go from purely accounting functions to message switching. However, advancements in technology were necessary to provide computers with large memories, fast operations and simultaneous processing capability.

Basically, message switching computers receive written messages, train consists and the like in teletypewriter format (100 wpm, for example), plus data transmitted directly from punched cards or from paper or magnetic tape. MSC writes the messages onto a magnetic core or drum or disk file. Because all messages have an address, the computer reads the address and selects an outgoing communications circuit over which the message is sent to destination. All this takes less time than it will take you to read this. Although it may take several minutes for total transmission time (a train consist), the switching is accomplished within a fraction of a second.

Twenty railroads have MSCs in service or about to go into service. As the table indicates, these devices operate 24 hours daily, the year around. While most roads use message switching computers for handling administrative messages, train consists, and the like, Canadian National has put its three computers to work handling airline and railway reservations.

Although U.S. railroads are not as generally passenger oriented as CN, some railway experts have predicted that such computer handling of reservations might well be applied to empty freight car distribution. As empty cars become available, car initial and number along with an appropriate type symbol would be fed to the computer. Any local agent or freight sales office could inquire as to availability of empty cars. A computer print out either on paper or a video display would list cars available by type and location.

All but two railroads reported that

(Text continues on page 32) (Computer characteristics are shown on pages 26-31)

What plans railroads have for TRAIN

Railroad	Facility to input data	Frequency of input	Frequency of inquiry
AT&SF	Paper tape at 750 wpm	Once a day	As needed
BAR	Not known	Daily	20 times/day
B&M	Paper tape 1,000 wpm	Daily	Several times daily
CP	100 wpm Teletype	Daily	Daily report
C&O/B&O	Magnetic tape	Daily	—
CB&Q	66 wpm Telex	Daily	—
CMStP&P	Prescribed by TRAIN	—	Daily
D&H	Yes	—	—
D&RGW	As defined by TRAIN	—	—
GN	Direct from computer at 2400 bits/sec continuous	—	—
IC	Tape-to-tape	Daily	Daily
L&N	Real time via card or tape, high or low speed	—	As often as can
PC	Magnetic tape by mail	Daily	—
RDG	IBM 1050 punched cards	3 times daily	—
RF&P	Depends on AAR	—	—
SOO	100 wpm Teletype	Daily	—
SP	100 wpm Teletype	Probably 3 times daily	Not known yet

Message switching computers are handling millions of characters

Railroad	AT&SF	CN	CP
Message switching computer	360/65	2-C8401, 1-C8560	360/40
In Service	1969	Dec. 1964	Mar. 1967
Location	Topeka, Kan.	Toronto, Ont.	Montreal, Que.
Manufacturer	IBM	Collins Radio	IBM
Hours and Days operated	24/7	24/7	24/7
Hardware maintenance	IBM	CNT	IBM
Messages in per day	70,000	143,000	6,000
Messages out per day	50,000	166,500	2,000
Average characters per message	300	300	1,200
Total characters in and out per day	3.5 million	90 million	8 million
Types of messages	Data, administrative	Airline, railway reservations, administrative & operations	Consists, originating waybill data, interchanges, inquiries, administrative
Computer:			
Fall back provided	Yes	Yes	Yes (duplicate system)
Core size	512K	64K, 256K	131K
Bits per word	32	16, 8	—
Mass storage: type	Disk	Bryant disk files	Disk
Capacity in characters	699 million	30 million	200 million
Fallback provided	Yes	Yes	Yes
Number of tape stands	5	7	—
Number of disk files	3	6	2314 of 8
Operating features:			
Speed conversion	Yes	Yes	Yes
Code conversion	Yes	Baudot, ASCII, EBCDIC	Yes
Format conversion	Yes	Yes	No
Message headings edited	Yes	Yes	Yes
Retrievals made	Yes	Yes	Yes
Incoming message numbers checked	Yes	Yes	Yes (assigned by computer)
Outgoing message numbers assigned	Yes	Yes	Yes
Date time assigned	Yes	Yes	Yes
Controls available	Network controlled	—	In CCAP software
Computer switchover	Manual	Yes	Manual
Can fallback computer be used for data processing	Yes	Yes	Yes
History tape	Yes	Yes	No
Logs kept	Yes	Yes	Message headers
Highspeed readout	Yes	Yes	Yes to disk
Lines: Speed	68.2 wpm, 100 wpm, 1200 bits	60 wpm, 66 wpm, 75 wpm, 100 wpm	66 wpm, 75 wpm
Number of lines:			
Full duplex non-controlled	—	151	—
Full duplex controlled	—	102	—
Half duplex non-controlled	—	—	—
Half duplex controlled	225	44	60
Simplex non-controlled	—	14	—
Simplex controlled	—	—	—
Other	—	—	1 Telex
Total number of lines	225	311	61
Outstations:			
Number	415	900	200
Terminal equipment type	33ASR, 35ASR, 35ACS, Teletype, 35ASR-D29 keypunch combination, Selectric teletype-029 keypunch combination	15, 19, 28, 32, 35 Teletype Western Union card reader	Teletype, Telex, Tel-A-Dex (two keypunch machines connected to a teletype to give card input and output)

daily in performing a real-time, on-line service.

C&O/B&O		C&NW	CB&Q	D&RGW
—	—	Spectra 70	360/40	—
June 1967	Dec. 1966	May 1968	Jan. 1968	Feb. 1967
Baltimore, Md.	Huntington, W.Va.	Chicago, Ill.	Chicago, Ill.	Denver, Colo.
RCA	RCA	RCA	IBM	GE
24/7	24/7	24/7	24/7	24/7
RCA	RCA	RCA	IBM	GE
12,700	5,000	100,000	1,000	—
19,000	6,500	35,000	1,000	—
2,100	870	80	5,000	—
66.6 million	10 million	10.8 million	10 million	5 million
Consists, movement reports, car tracing, Telscar reports, administrative		Consists	Inquiry, retrieval, control, message switching	Administrative, transportation system
Yes	Yes	Yes	Yes	Yes
120K	100K	132K	256K	16K
Character machine		8	8	20
Drum	Drum	Disk	2314 Disk	Disk
1,311K	655K	7.5 million	233 million	20 million (each)
Yes	Yes	Yes	Yes	Yes
5	4	6	5	3
—	—	5	1	4
Yes	Yes	No	Yes	Yes
Yes	Yes	Yes	Yes	Yes
No	No	No	No	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	No	Yes	Yes
Yes	Yes	No	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Circuit and station error notification recall, rerouting		Yes	Yes	Yes
Yes	Yes	Yes	Manual cutover to computer backup	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
No	No	No	No	Yes
(14) 75 wpm (47) 100 wpm	(31) 100 wpm	(14) 2400 baud Wats (11) 150 baud	50 baud, 75 baud, 110 baud, 134 baud	60 wpm, 75 wpm 100 wpm
(3) Video D.T.	—	—	—	—
(2) ICL & DXC	ICL	—	—	30
—	—	—	—	—
61	31	25	36	—
—	—	—	—	—
—	—	—	8 switched	—
—	—	—	—	—
66	31	25	44	30
498	240	83	36 and Telex	60
83B3	83B3	IBM 1050	Teletype with CAE translator to keypunch 1050 for general office inquiry, Telex	33, 35 Teletype

Twenty railroads have message switching computers, and most

Railroad	DM&IR	GN	IC
Message switching computer	360/40	——	360/50
In Service	Sept. 1968	June 1968	Nov. 1967
Location	Joliet, Ill.	St. Paul, Minn.	Chicago, Ill.
Manufacturer	IBM	Univac	IBM
Hours and Days operated	24/7	24/7	24/7
Hardware maintenance	IBM	Univac	IBM
Messages in per day	Not known at this time	900	14,000
Messages out per day	——	2,300	15,000
Average characters per message	——	4,500	1,615
Total characters in and out per day	——	14.4 million	21 million
Types of messages	——	Consists, car moves, administrative, terminal status (input and output)	Administrative, data system control, inquiry
Computer:			
Fall back provided	Yes	Yes	Yes
Core size	131K	64K	262K characters
Bits per word	——	18	32
Mass storage: type	Disk	Fastrand + FH-880	None
Capacity in characters	24 million	136.8 million	——
Fallback provided	Yes	Yes	——
Number of tape stands	1	3 + backup 3	2 used from pool of 16 drives
Number of disk files	3	2 drums + 2 backup	(3) 2311, (1) 2314 (8 modules)
Operating features:			
Speed conversion	——	Yes	Yes
Code conversion	——	Yes	Yes
Format conversion	——	Yes	Yes
Message headings edited	——	Yes	Yes
Retrievals made	——	Yes	No
Incoming message numbers checked	——	Computer assigned	Yes
Outgoing message numbers assigned	——	Yes	Yes
Date time assigned	——	Yes	Yes
Controls available	——	——	Full switcher control through 1050 via system message tapes
Computer switchover	Yes	Yes	Manual
Can fallback computer be used for data processing	Yes	Yes	Yes
History tape	Yes	Yes	Yes
Logs kept	Yes	Yes	Yes
Highspeed readout	Yes	Yes	Yes, via printer
Lines: Speed	150 baud	75 wpm, 100 wpm 134 wpm, 2400 bits/sec	(43) 134.5 baud, (32) 74.2 baud (14) 56.8 baud, (7) 50 baud Telex, (2) 110 baud TWX
Number of lines:			
Full duplex non-controlled	——	——	——
Full duplex controlled	——	——	——
Half duplex non-controlled	——	——	——
Half duplex controlled	2	60	98
Simplex non-controlled	——	——	——
Simplex controlled	——	4	——
Other	——	——	——
Total number of lines	2	64	98
Outstations:			
Number	8	89	174
Terminal equipment type	IBM 1050, Sylvania ACI scanners	IBM 1050, 28 and 35 Teletype, DCT 2000	(56) IBM 1050 (79) 2BASR 100 wpm (39) 2BASR 75 wpm

other large roads indicate that they will also install such computers.

L&N	MP	PC	
360/40	360/50	7740	——
May 1967	Aug. 1968	Jan. 1967	Oct. 1963
Louisville, Ky.	St. Louis, Mo.	Philadelphia, Pa.	New York, N.Y.
IBM	IBM	IBM	Collins Radio
24/7	24/7	24/7	24/7
IBM	IBM and MP	IBM	PC
5,000	——	18,000	7,300
6,100	——	9,700	12,500
1,170	——	964	3,400
13 million	——	30 million	67 million
Consists, interchanges, administrative, car orders, accounting	Consists and car data	Car movements, ACI, inquiries, administrative	
360/50	Yes 360/50	Yes	Yes
512K bytes	128K	16,384 words	65K
32 + 1 parity (4 bytes)	32	32	16
——	IBM 2314 disk	Disk	Disk
——	——	66 million	20 million
——	Yes	Yes	Yes
——	——	8	4
(2) 2314	——	6	1
Yes	——	No	Yes
Yes	——	Yes	Yes
Yes	——	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Message log	No	Yes
Yes	——	No	Yes
Yes	——	Yes	Yes
Yes	Yes	Redirect, skip	Redirect, hold, skip
2911 for channels 1925 for lines	——	Manual	Automatic
Yes, 24 hr/day	Yes	Yes	Yes
Yes	Yes	Yes	No
Yes	Yes	Yes	Yes
Yes	——	Magnetic tape	Magnetic tape, Line printer
——	60 wpm	100 wpm	100 wpm
——	——	——	37
——	——	——	——
——	(11) data channels	——	——
62	(5) Telex car tracing, administrative	84	30
——	——	——	101
——	——	——	23
——	——	——	——
62	16	84	191
126 L&N, undisclosed number for shippers	47	809	491
IBM 1050, IBM 2260, Telex, TWX	Teletype, IBM 1912	Teletype 28, IBM 1050	Teletype 28 and intercouplers

Most roads with older models are planning to replace them with

Railroad	RDG	StL-SF	SCL
Message switching computer	(2) 1440	360/40	—
In Service	Nov. 1966	Jan. 1968	Feb. 1965
Location	Philadelphia, Pa.	Springfield, Mo.	Jacksonville, Fla.
Manufacturer	IBM	IBM	IBM
Hours and Days operated	24/7	24/7	24/7
Hardware maintenance	IBM	IBM	IBM
Messages in per day	1,350	3,400	1,700
Messages out per day	450	3,900	600
Average characters per message	1,538	750	4,000
Total characters in and out per day	2.8 million	5.5 million	9.2 million
Types of messages	Administrative, car movement, inquiry	Operating data, administrative, inquiry	Interchanges, consists, inquiry
Computer:			
Fall back provided	None	No	IBM 1460
Core size	16K	64K	16K per 1460
Bits per word	BCD variable word length	32	8 bits/character
Mass storage: type	1311/1301 Disk	Disk	1311 Disk
Capacity in characters	26 million	58 million	2 million/1311
Fallback provided	7335 magnetic tape	No	Yes
Number of tape stands	2	2	4
Number of disk files	5	8	7
Operating features:			
Speed conversion	—	Yes	Yes
Code conversion	—	Yes	Yes
Format conversion	—	Yes	Yes
Message headings edited	Yes	Yes	Yes
Retrievals made	Yes	Yes	Yes
Incoming message numbers checked	Yes	Yes	Yes
Outgoing message numbers assigned	Yes	Yes	Yes
Date time assigned	Yes	Yes	Yes
Controls available	Start/stop line	Both network and computer	Configuration, switching and others
Computer switchover	No	No	Yes
Can fallback computer be used for data processing	—	None	Only for on-line processing
History tape	Yes	Yes	Yes
Logs kept	Yes	Yes	Yes
Highspeed readout	Yes	No	No
Lines: Speed	150 baud	60 wpm, 66 wpm, 100 wpm	150 baud and voice grade
Number of lines:			
Full duplex non-controlled	—	—	—
Full duplex controlled	—	—	—
Half duplex non-controlled	—	—	30
Half duplex controlled	14	27	—
Simplex non-controlled	—	—	—
Simplex controlled	—	—	—
Other	—	—	—
Total number of lines	14	27	30
Outstations:			
Number	(21) 1050, (22) 2740	165	67
Terminal equipment type	IBM 1050 yard offices, IBM 2740 sales and administrative offices	Teletype, Telex IBM 1050	IBM 1050, 1051, 1053, 1056, 1058

new solid state, third-generation message switching computers.

SOO	SOU	UP	WP
360/40	(2) 7740	360/65	DN 30
Sept. 1968	Sept. 1964	Apr. 1968	Sept. 1967
Minneapolis, Minn.	Atlanta, Ga.	Omaha, Neb.	San Francisco, Calif.
IBM	IBM	IBM	GE
24/7	24/7	24/7	24/7
IBM	IBM	IBM	GE
—	120,000-150,000	2,302	300
—	30,000	4,011	1,450
—	30	3,913	2,060
3 million	4.75 million	24.7 million	3.5 million
Consists, interchanges, administrative, car status reports	Waybill data, car moves, edit detected input errors, tonnage reports	Consists, administrative	Consists, administrative
Yes	Duplicate machines	Yes	Yes
131,072 bytes	16,384 words	262K bytes	16K
32	32	32 (4 bytes/word)	18
IBM 2311	None—strictly on-line to main processor	(2) 2314	Disk
7.25 million	—	465 million	18.3 million
3 Disk files	—	Yes	Yes
None	—	12	8
7	—	16	2
Yes, hardware	60 & 100 wpm TWX, 66 wpm Telex, IBM 1050	Yes	Yes
Yes, software	Baudot, ASCII, IBM BCD	Yes	Yes
Yes, software	None	Yes	Yes
Yes, software	None	Yes	Yes
Yes	None	Yes	Yes
Yes	None	No, assigned	Yes
Yes	None	Yes	Yes
Yes	Yes	Yes	Yes
Yes, programming	—	Changeable polling interval. Operator controlled re-route capability.	Many supervisory controls
Yes, manual with program help	Special design manually operated relay network	Manual	Yes
Yes	No	Yes	Yes, and is
Yes	Kept by main processor	Yes	Yes
Yes	Kept by main processor	Yes	Yes
High speed printer	Kept by main processor	No	Yes
(4) 150 baud	60 and 100 wpm TWX	(52) 134 baud	75 wpm
(8) 75 baud	66 wpm Telex, IBM 1050	(42) 75 baud	42K chars/sec
—	—	—	—
—	—	—	28
—	48	—	—
12	36	94	—
—	—	—	—
—	—	—	—
—	—	—	—
12	84	94	28
30	30 in house, Customers teletype, several hundred	112	56
(2) IBM 1050 card oriented, (28) Teletype model 28	TWX models 28, 33, 35, IBM 1050 and specially modified teletypes	(63) IBM 1050, (49) model 28 Teletypes	Model 28 Teleype

Present and future use of computers by railroads portends ever increasing demands upon communications facilities. On-line, real-time computing requires accurate, reliable communications.

(Continued from page 25)

their message switching computers are in duplicate. In some cases, the duplicate computer is not the identical model as the on-line unit. Most roads use the standby unit for batch processing, but it can be interrupted to handle message switching. Some roads such as CN and NYC district of Penn Central have full duplicate units. Both computers are used for message switching.

From the table it is apparent that millions of characters are handled daily by these switchers, hence the requirements of large, extremely fast processors. Because of their multi-processing ability (can handle several processing functions simultaneously), railroads often have these computers handle several chores at the same time. Several railroads reported plans to install second and even third MSCs to handle the myriad of tasks additional to purely message switching.

Also in the works for several railroads are additions of TWX and Telex circuits to these message switchers to handle inquiries from customers regarding car location information.

The two roads not having present standby computers for message switching will have such capability next year when new computers are placed in service.

Sixty or 100 wpm teleprinter circuits are used by most all roads for input to and output from these MSCs. In all or most instances, the computers poll the various outstations. When polled, a station replies that it has a message for the computer, or that it is in the receiving mode (computer can send a message to it).

However, where customer inquiry is available or will be added, the customer's outstation will initiate the call to the computer.

Computer-to-computer high speed data links are used by some roads for handling data and messages between them. Most of these high speed lines are or will operate at 1200 or 2400 bits per second. Some of them use magnetic tape or disk files for the storage medium at either end of the circuit.

For the future, there is thinking in some areas, particularly among the communications engineers, that if computers can switch messages, why not have them switch telephone calls. It takes but little imagination to visualize a freight sales office or a railroad official's office with such tele-processing capability. Equipment in such an office could provide readout in forms of video displays (cathode ray tubes), paper tape, multi-copy paper forms, facsimile, voice recordings, or the actual voice, and electronic pens that make drawings.

For input, the official could use an electric typewriter, conventional dial telephone, electronic pen for making drawings or sketches, facsimile or intercom units so he can talk while moving about his office.

With the highspeed message switchers or teleprocessing units available or under development, the various types of communications inputs can be switched among two or more stations. Even voice-actuated typewriters have been developed in laboratories.

So, tomorrow's railroad official makes a telephone call to a customer, and is able to leave a written record at the customer's office, should said customer be away. For the local freight sales agent, the reverse would be of tremendous help, and a timesaver. He dictates the waybill information over the telephone, and the computer prepares the waybill.

Although the survey revealed only 20 railroads with message switching computers, nearly all 50 roads reported at least interest in such devices. Several roads which are in the process of planning for extensive computer installations, put teleprocessing (message switching computer capability) high on the list of vital equipment.

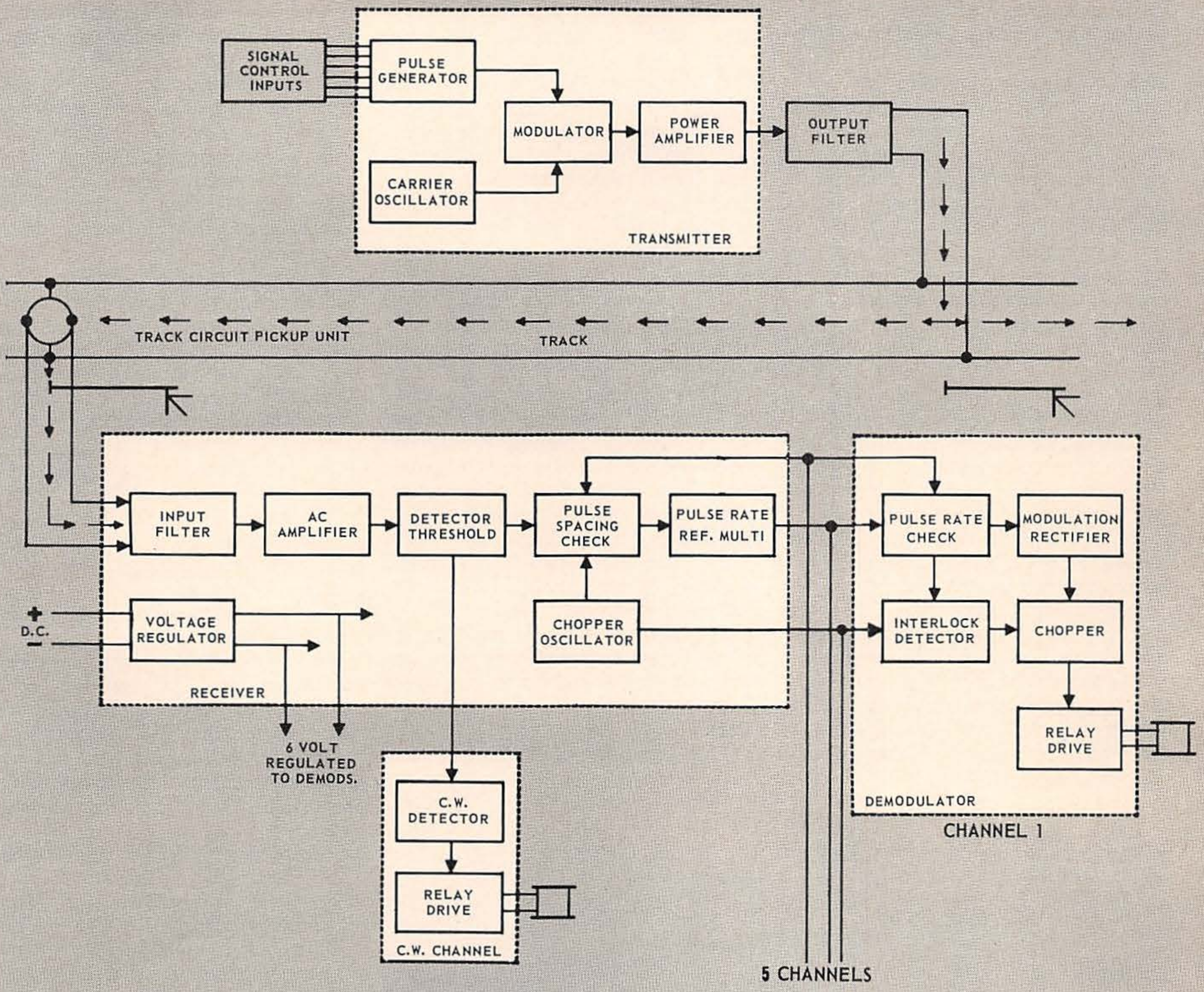
So the computer which started out as a highspeed calculator, has now become a highly sophicated integral unit of railroad operations, due mainly to its multi-processing capability. Railroad computer usage has only one way to go, that's up.

Figure 1—Simplified block diagram shows the electronic track circuit using pulse modulation control techniques.

Electronic

An electronic track circuit for automatic block signal systems is available that eliminates insulated joints at intermediate signals and requires no line wires to transmit logic.

As railroad technology has advanced over the years the cost of installation and maintenance of insulated joints, line wires and electromechanical instruments has increased. The welded rail program has stressed the importance of not only reducing, but eliminating insulated joints in main line track. Electronic track circuits using the inductance property of the rail for isolation have been widely used without insulated joints in recent years to operate automatic highway crossing protection equipment.


SIGNAL CONTROL INPUTS
PULSE GENERATOR
MODULATOR
POWER AMPLIFIER
CARRIER OSCILLATOR
TRANSMITTER
OUTPUT FILTER
TRACK CIRCUIT PICKUP UNIT
TRACK
INPUT FILTER
AC AMPLIFIER
DETECTOR THRESHOLD
PULSE SPACING CHECK
PULSE RATE REF. MULTI
VOLTAGE REGULATOR
CHOPPER OSCILLATOR
+
D.C.
−
RECEIVER
6 VOLT REGULATED TO DEMODS.
C.W. DETECTOR
RELAY DRIVE
C.W. CHANNEL
5 CHANNELS
PULSE RATE CHECK
MODULATION RECTIFIER
INTERLOCK DETECTOR
CHOPPER
RELAY DRIVE
DEMODULATOR
CHANNEL 1

track circuit has pulse modulation

The pulse modulated control, PMC, manufactured by Marquardt Industrial Products Co., MIPCO, is an advanced track circuit for automatic block signaling that transmits control information through the rails. The track circuit alternating currents are in the audio frequency range and are coded by pulse modulation. Receiving equipment is designed to detect the proper carrier frequency intended for a signal location and decode the modulation component to develop the signal aspect control voltage. Frequency and code separation is used to prevent crosstalk between adjacent signal blocks.

PMC development at MIPCO originated in 1965 when experiments were made on a six-mile test track using electronic track circuits which were interfaced with DC coding relays for encoding and decoding. The results were unsuccessful because of variations in the symmetry of the received coding signal with changes in ballast conditions. This was caused by the slow response of resonant circuits in the low frequency transmitter and the fixed threshold setting in the receiver circuit. Also, there were serious problems of isolation between systems operating in both directions on the same track.

As a result of these preliminary tests, a system was developed that could perform over long track circuits without the limitations which were originally encountered.

The MIPCO system uses a pulse modulated audio frequency carrier transmitted through the rails. No line wires are used and, by taking advantage of the audio frequency track circuit characteristics and making use of a unique receiver pickup device, insulated joints are not needed. The receiving system responds only to pulses, or pulse groups, of the proper audio frequency carrier. Low frequencies are used to gain operating distance under adverse ballast conditions.

In many respects the PMC track circuit is analogous to the familiar AC or DC coded track circuit. The bursts of audio frequency carrier might be compared with "on pulses" of code, except that PMC transmits pairs of pulses of the proper spacing. The repetition rate between pulse pairs (identified as modulation rate) properly identifies the signal. The desired repetition rate is established by external relay logic.

The pulsed-carrier system has several advantages as a track circuit:

(1) The transmitter battery drain is lower for a pulsed system than for a continuously operating transmitter having the same track drive.

(2) Several bits of data can be transmitted on one carrier, permitting control of multiple signal aspects.

(3) Strong interference from outside sources will cause the pulse receiver to lose timing information and consequently drop the track relay. Steady state energy from power lines or overlay frequencies can only result in a loss of signal due to saturation of the detector circuit. This results in continued safe operation under all normal conditions and "safe failures" in the event foreign currents and interference increase greatly in magnitude.

Design specification for PMC was derived through discussions with engineers in various railroad signal departments, through study of AAR requisites and ICC regulations, and by the Marquardt technical staff. In addition to the usual requirements of broken rail protection and adequate shunting sensitivity, some of the system requisites were:

(1) The system shall transmit modulated tones into the track circuit. The use of steady carrier signals to control vital signal functions is inadequate.

(2) The receiver must be frequency selective and capable of decoding the modulated signal. The decoding circuits must not respond to other modulation codes.

(3) Overlapping track circuits shall use different carrier frequencies and modulations. Separation by carrier frequency alone is inadequate.

(4) The receiver shall not become energized by interference from foreign current, electric propulsion current, coded cab signals, adjacent transmitter crosstalk, or radiated fields from power transmission lines, or radio broadcast transmitters.

(5) Track circuit definition at signal locations without insulated rail joints shall not exceed 5 ft.

(6) Provisions shall be made in the system design to repeat track circuit information in the middle of long signal blocks without the use of insulated rail joints.

(7) A capability of 10 distinct modulations, five in each direction on the same track, is required for use in signaling systems not having insulated rail joints or line wires. The use of a steady carrier or continuous wave signal is permissible for control of non-vital functions such as approach lighting.

(8) The receiver shall use modular plug-in construction to permit the addition of modulation channels to the basic package.

(9) The transmitter shall be capable of sending all modulation codes to match the track circuit receiver. Changes in modulation are accomplished through external relay control.

(10) The receiver shall be capable of operating standard signal line relays.

(11) The equipment must be capable of operating satisfactorily in areas of extreme temperature and humidity range without need for special housing.

(12) The equipment must be capable of operating in electrified territory, both AC and DC propulsion.

(13) The equipment must be compatible with all existing types of cab signal and/or train control in electrified or non-electrified territory.

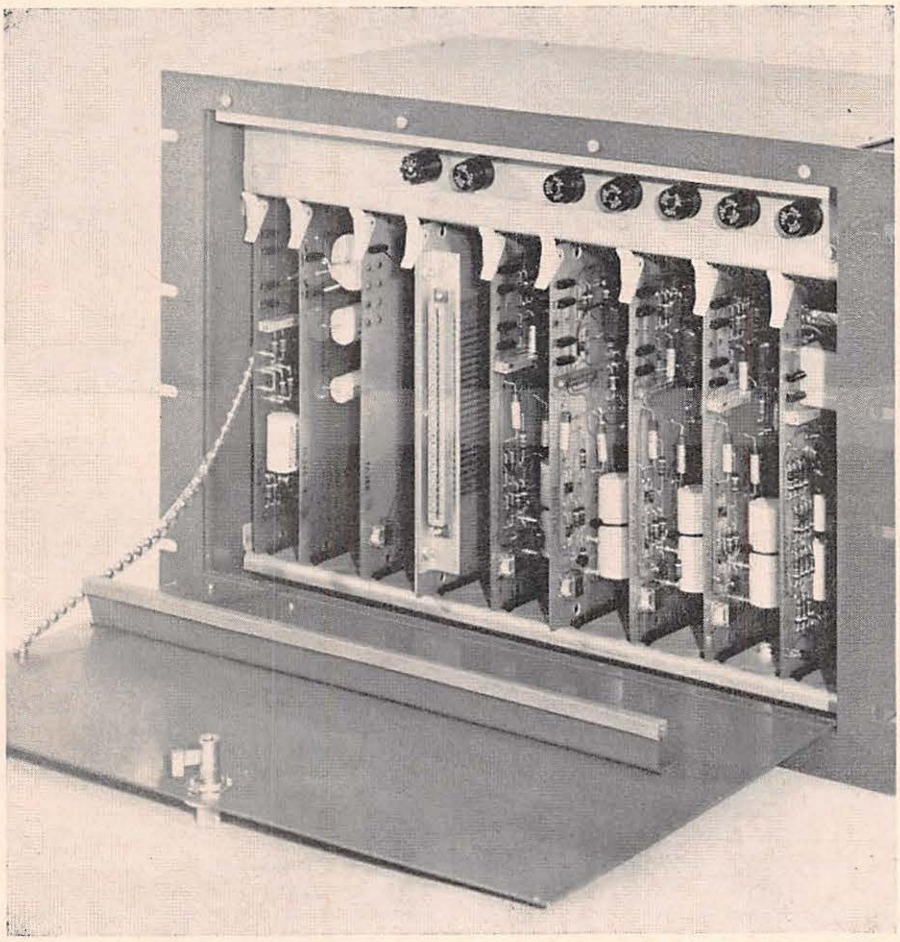
A circuit design philosophy was adopted for the PMC equipment in keeping with fail-safe concepts traditional in railway signaling systems. Some of these design considerations were:

- Amplifiers in receiver circuits should be designed to eliminate the possibility of self-oscillation. High gain amplifiers using AC feedback for stability, and tuned collector, tuned base amplifiers can become unstable because of a component failure and should be avoided.
- Carrier detector circuits should be reverse-polarized from the battery supply connections so that leakage currents, due to component failure, will not cause erroneous indications.
- Relay drive voltages should be obtained through a transformer-coupled bridge rectifier to isolate the relay coil from battery potentials. The relay drive should not be connected to any battery common bus lines to insure maximum security against possible leakage currents.
- Solid-state logic networks must be backed up with a fail-safe check signal to insure that an unsafe condition does not result if the semiconductors become shorted or open.
- The circuit design shall be such that a component failure in either a shorted or open circuit will not result in an unsafe condition.

The simplified block diagram of a PMC track circuit (Figure 1) illustrates the major functional operations of the transmitter and receiver units.

A carrier oscillator in the transmitter

(Please turn to page 36)



PMC system uses plug-in modules. Shelf-mounted case also fits 19" rack.

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Circle 17 on reader service card on page 78

TRACK CIRCUIT

(Continued from page 34)

generates the audio tone which is modulated by a pulse generator circuit. The modulation is controlled by relays in the wayside control circuits. The resultant signals are amplified and filtered to produce high current audio pulses in the rails. These pulses are coded so they will actuate a receiver which is preset to decode this signal and reject all others. The transmitter output characteristics are shown in Figure 2.

The track signals are inductively coupled into the receiver input through a preamplifier where they are filtered, permitting only signals of the proper frequency to pass. The AC amplifier brings the signal up to a workable voltage level so it can be detected and applied to a threshold circuit. Pulse signals exceeding the threshold must successfully pass a pulse-spacing check and a pulse rate check before the modulation is accepted. When this occurs, the modulation rectifier produces a DC output which is chopped to produce a relay drive voltage.

The chopper oscillator signal is connected to the chopper through an interlock network which insures the integrity of the solid-state logic circuitry in the timing check circuits.

The signal aspect information is transmitted by changes in modulation which are accomplished by relay contact closures. Each code is detected by a different plug-in module board in the PMC chassis.

The shunting sensitivity of the PMC represents a remarkable advance in AC track circuit performance. The receiver input voltage is derived from an inductive track circuit pickup unit which senses rail currents and rail voltages. When the track is unoccupied, the inter-rail voltage provides the input signal to the receiver.

A plot of the PMC track circuit shunting characteristics is shown in Figure 3. As a train approaches the signal location, the shunting effect of the axles reduces the track voltage. At the same time, the track current passing the signal location is increasing because of the train shunt and the receiver continues to have a strong input signal until the train enters the block. This performance is based on the design of the track circuit pickup unit, a specially designed transformer that produces an output voltage proportional to rail current and rail voltage. This unit makes it possible for the system to detect an approaching train at a signal location with an accuracy of ±1 ft. The same advantage in shunting that is inherent in DC code systems, the fact that energy is removed between code pulses, is

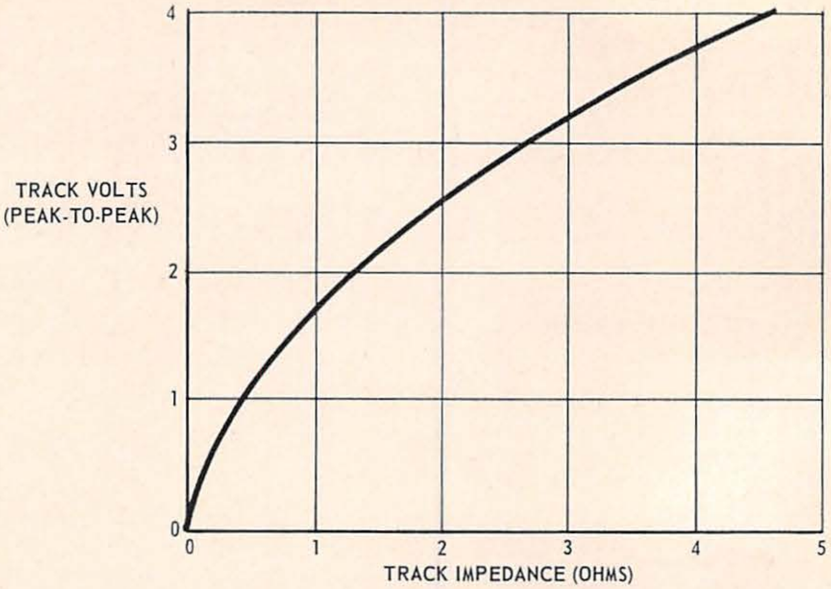
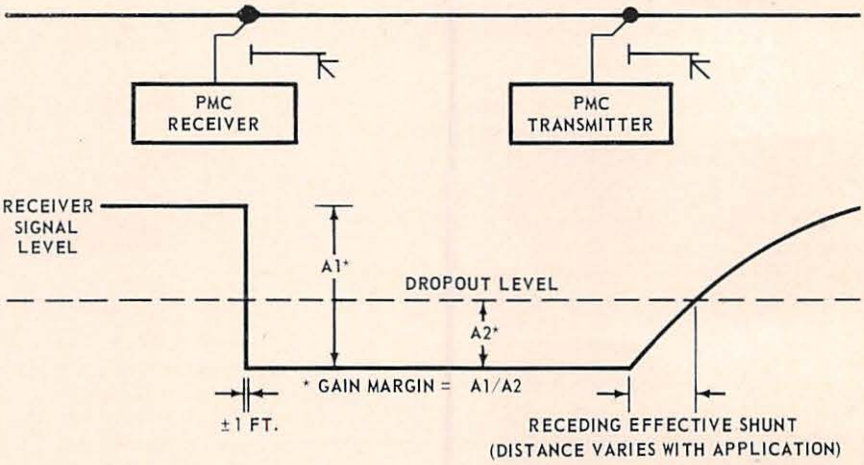


Figure 2—Output characteristics of the PMC transmitter.



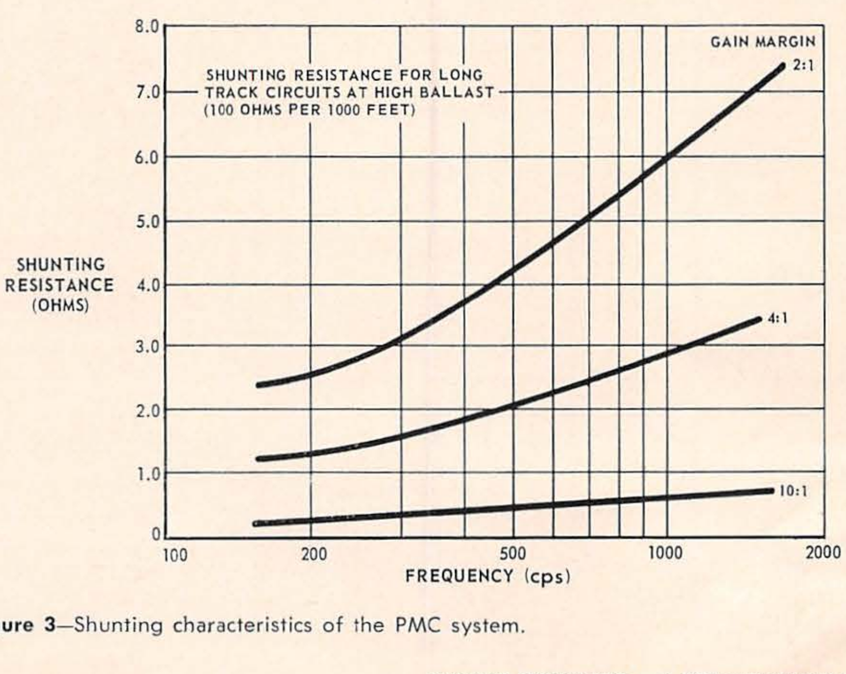


Figure 3—Shunting characteristics of the PMC system.

also obtained in the PMC system. Consequently, the train is shunting against pickup instead of having to force a dropout under continuous signal conditions. The gain margin is adjusted by the receiver gain control and is set at installation to give the desired system performance.

Care must be used in selecting frequencies to determine that proper shunting sensitivity is obtained at the fouling point. The audio frequency affects the fouling point as does the rail surface condition. The graph of fouling distance vs shunting resistance shown in Figure 4 illustrates the most distant point where the track circuit will still deenergize due to a shunt on the siding. A shunting sensitivity of .36 ohms, typical for PMC circuits, has been assumed to plot the graph.

The maximum distances PMC frequencies will operate are limited by four primary factors—transmitted power level, receiver sensitivity, signal losses caused by low ballast conditions, and broken rail protection requirements. It is well agreed that electronic track circuits offer no "cure-all" for low ballast resistance. Actually, the limitations to this equipment are fairly similar to other types of pulsing circuits. Since broken rail protection is required at all ballast conditions, this factor must be considered first. Tests have been made at each PMC installation to verify calculated broken rail protection of the equipment. Many of these tests were conducted under very adverse conditions and in all cases, the broken rail protection performed satisfactorily. A graph of maximum distance versus ballast resistance to obtain broken rail protection is shown in Figure 5. This graph shows the maximum distance a circuit can be extended to operate, without adjustment, down to a minimum expected ballast resistance value. For example, at 156 Hz a maximum distance of 14,000 ft can be reached if the ballast resistance drops to 10 ohms per 1000 ft. Good broken rail protection will be realized if the gain margin is less than 9 to 1 which is insured because of total track circuit loss under low ballast conditions.

The data in Figure 5 is based on 20 ohm leakages to ground from the broken rail, or an equivalent 40 ohm series resistance in the track resistance. This is an arbitrary number since no constant value can be assigned common to all track circuits for all weather and ballast conditions.

In certain areas, the extensive application of concrete cross ties have presented operating problems with long DC coded track circuits. Tests have indicated that PMC circuits perform satisfactorily on concrete cross ties.

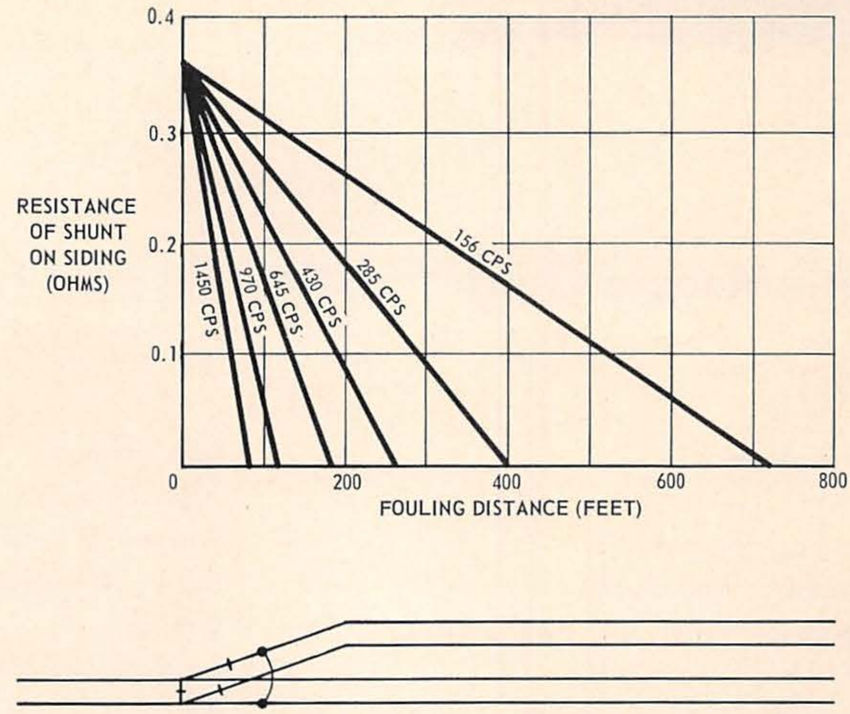


Figure 4—Fouling distance vs shunting resistance data.

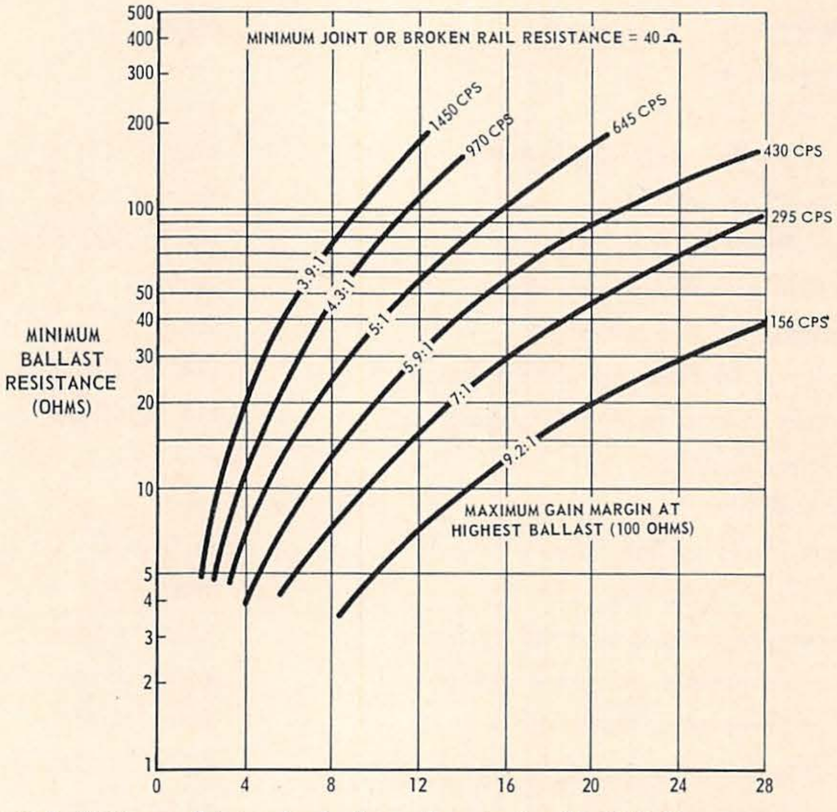


Figure 5—Maximum distance for broken rail protection (X 1000 ft).

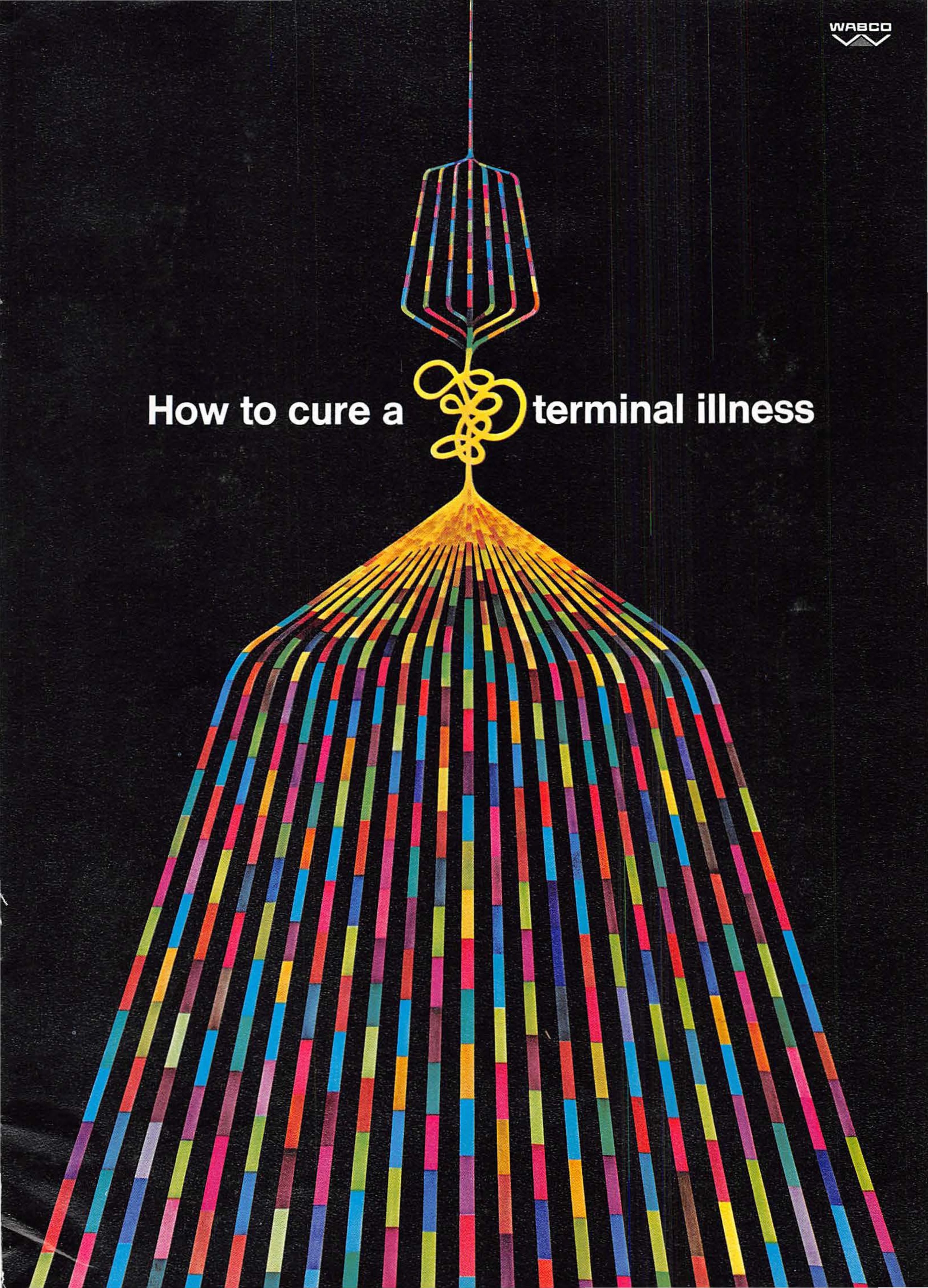
The PMC system is furnished in a specially designed case using plug-in modules for easy replacement. The case is so designed as to mount on standard 19" rack, be shelf-mounted, wall-mounted or inserted in a case backboard. Under special requirements the equipment may be furnished in separate containers similar to those used on standard overlay equipment.

All tests as well as "in-service installations" to date indicate highly dependable performance with PMC circuits. Installations have been operating through all conditions of low ballast due to snow, heavy rains and accumulated dust.

Data Modem Characteristics

Prepared by Leo J. Ritter Staff Engineer, Communications & Signals, Penn Central. Reprinted by permission of George McCann, Secretary, Communication & Signal Section, AAR.

Manufacturer	Bell System	Bell System
Model	103A Data Set	103A1 Data Set
Transmit and/or receive	Transmit & Receive	Transmit & Receive
Full and/or Half Duplex	Full or Half duplex	Full or Half duplex
Dial up or Private Line Application	Dial up	Private Line
Turn around time (HDX)	Controlled by data eqpt	Controlled by data eqpt
Automatic answer capability	No	Not applicable
Type modulation	Frequency shift	Frequency shift
Operating Frequencies	1170 & 2125 Hz	1170 & 2125 Hz
Clock, internal or external	None	None
Loop back testing feature	Yes	Yes
Error rate	— — —	— — —
Error detection and/or correction	None	None
EIA RS-232-B interface	Yes	Yes
Bit or character rate	Up to 300 bits/sec	Up to 300 bits/sec
Serial or parallel transmission	Serial	Serial
Impedance to line, ohms	900	900
Impedance to data equipment, ohms	EIA RS-232-B	EIA RS-232-B
Voltages to and from data equipment	EIA RS-232-B	EIA RS-232-B
Frequency stability	— — —	— — —
Level stability	— — —	— — —
Output levels to line, dbm	−10 to 0	−10 to 0
Input levels from line, dbm	Min. −30	Min. −39
Line requirements, frequency response	Voice grade	Voice grade, to 2.8 kHz
Line requirements, envelope delay	Voice grade	Voice grade, to 2.8 kHz
Line requirements, impedance	Voice grade	Voice grade, to 2.8 kHz
Line requirements, signal to steady noise	Voice grade	Voice grade, to 2.8 kHz
Line requirements, signal to impulse noise	Voice grade	Voice grade, to 2.8 kHz
Method of operation	2 wire	2 wire
Temperature and humidity limits	+40 to +120 deg F	+40 to +120 deg F
Power requirements	120 volts, 15 watts	120 volts, 15 watts
Dimensions and weight	11" x 5" x 10", 15 lb	11" x 5½" x 10", 15 lb
Digital or analog	Digital	Digital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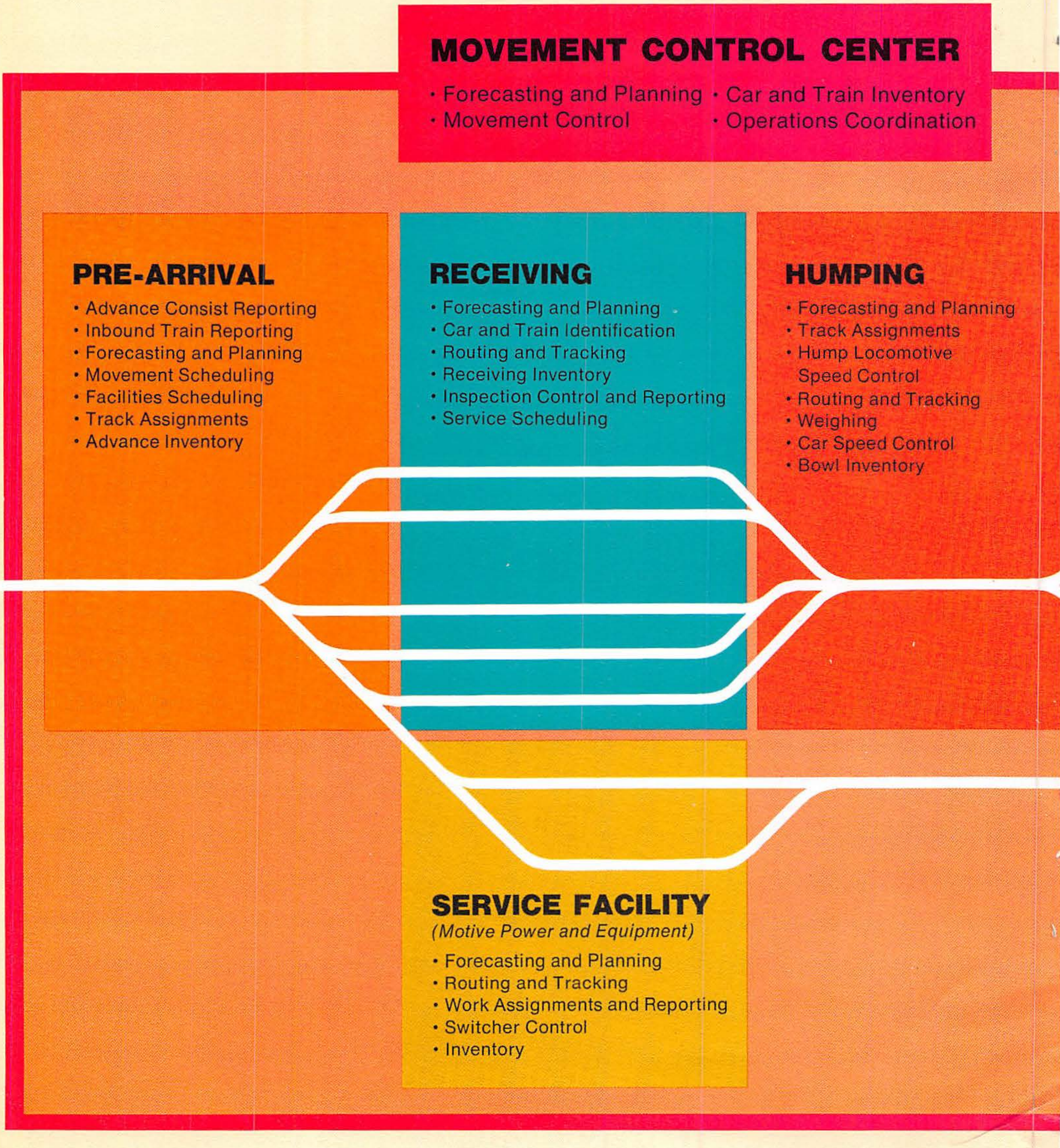

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- Movement Control
- Car and Train Inventory
- Operations Coordination

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- Inbound Train Reporting
- Forecasting and Planning
- Movement Scheduling
- Facilities Scheduling
- Track Assignments
- Advance Inventory

RECEIVING

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- Car and Train Identification
- Routing and Tracking
- Receiving Inventory
- Inspection Control and Reporting
- Service Scheduling

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- Track Assignments
- Hump Locomotive Speed Control
- Routing and Tracking
- Weighing
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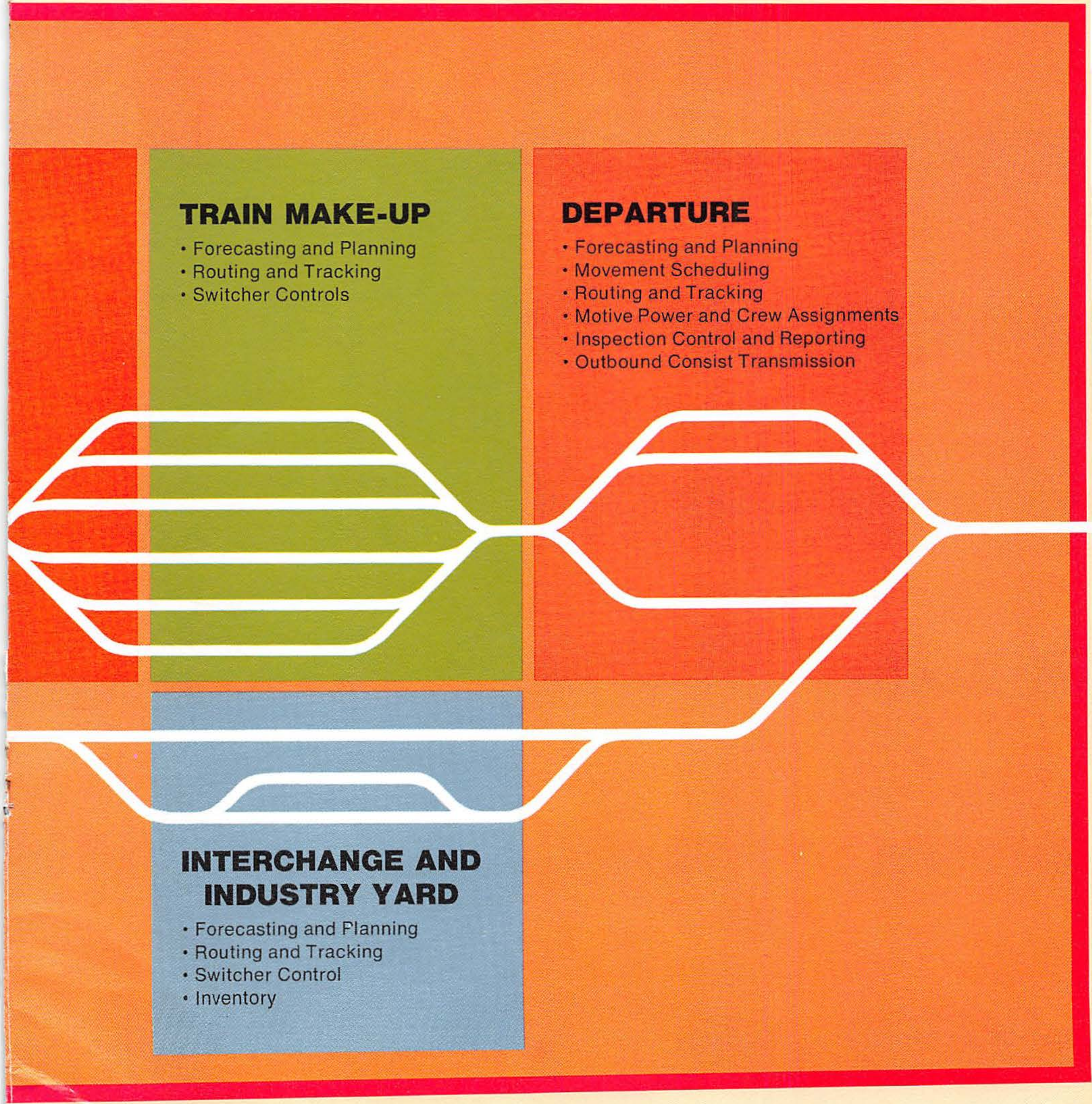

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- Routing and Tracking
- Motive Power and Crew Assignments
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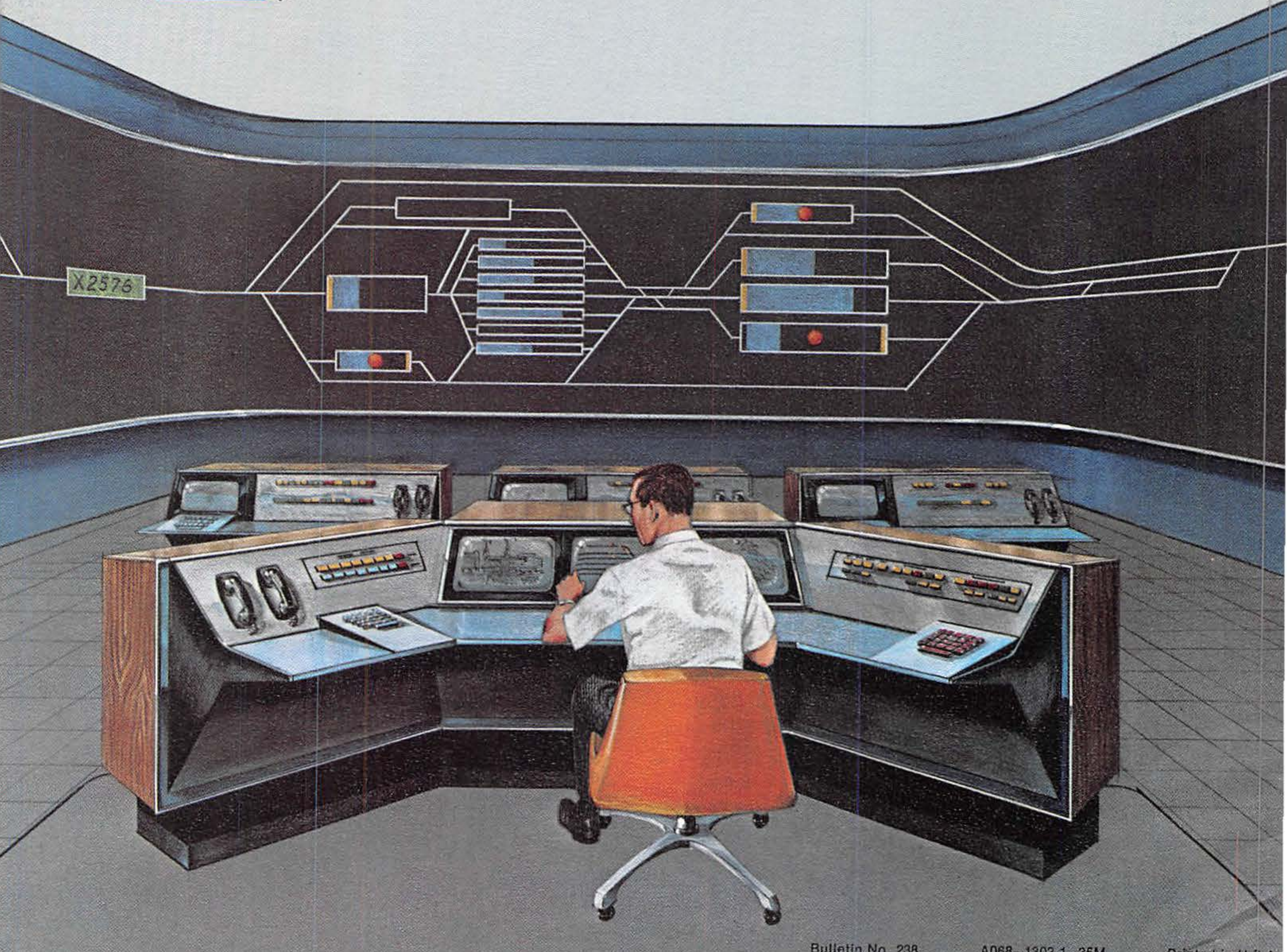

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Data Modem Characteristics

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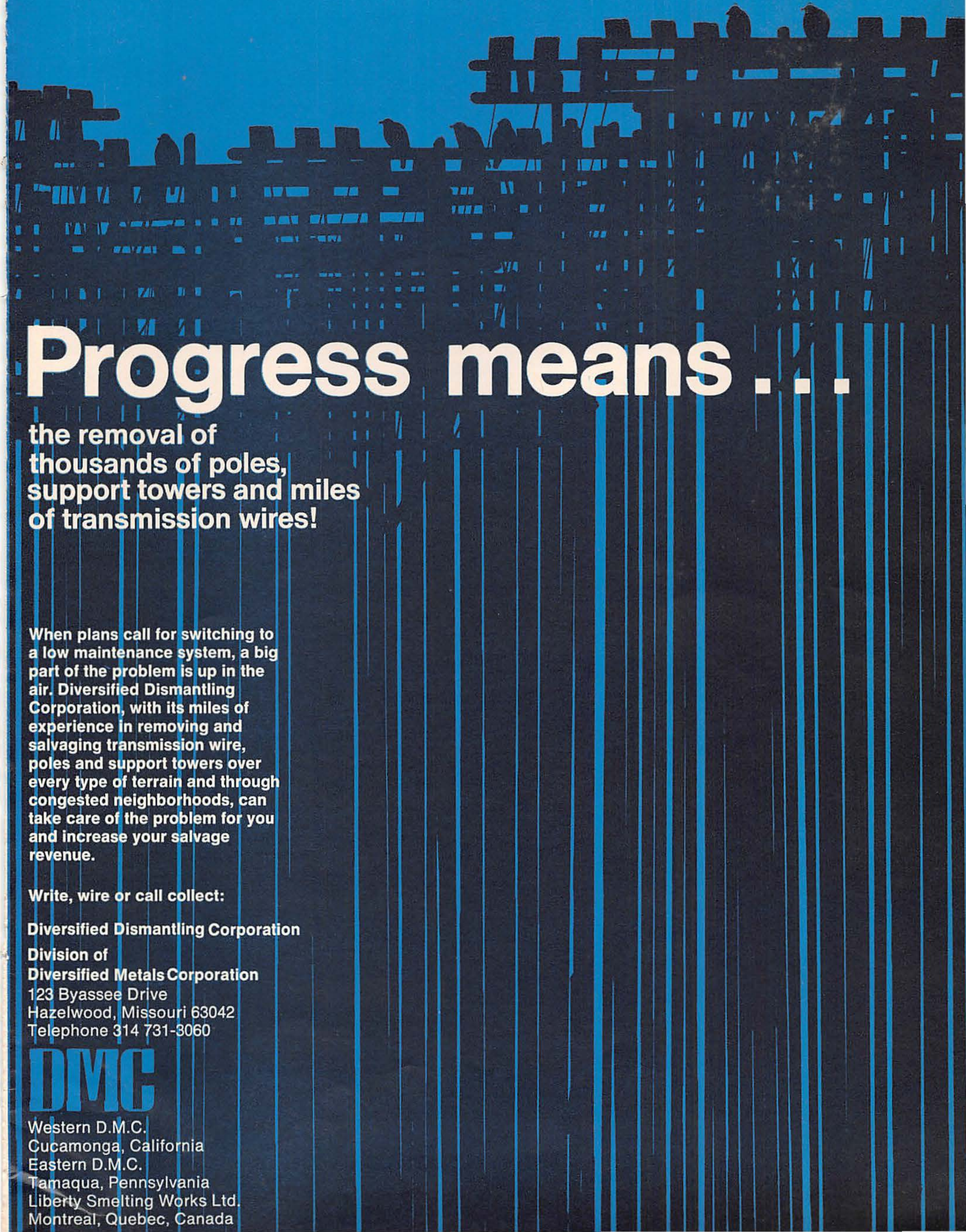
Manufacturer	Bell System	Bell System
Model	103F2 Data Set	303A-10 Data Set
Transmit and/or receive	Transmit & Receive	Transmit & Receive
Full and/or Half Duplex	Full or Half duplex	Full or Half duplex
Dial up or Private Line Application	Private line	Private line
Turn around time (HDX)	Controlled by data eqpt	Not applicable
Automatic answer capability	Not applicable	Not applicable
Type modulation	Frequency shift	Restored polar sig. conditioning
Operating Frequencies	1170 & 2125 Hz	28-44 kHz
Clock, internal or external	None	Internal
Loop back testing feature	Yes	Yes
Error rate	— — —	— — —
Error detection and/or correction	None	None
EIA RS-232-B interface	Yes	No
Bit or character rate	Up to 300 bits/sec	19,200 bits/sec
Serial or parallel transmission	Serial	Serial
Impedance to line, ohms	900	135
Impedance to data equipment, ohms	EIA RS-232-B	90-120
Voltages to and from data equipment	EIA RS-232-B	5 or 23 ma
Frequency stability	— — —	— — —
Level stability	— — —	— — —
Output levels to line, dbm	−10 to 0	0
Input levels from line, dbm	Min. −39	0
Line requirements, frequency response	Voice grade, to 2.8 kHz	— — —
Line requirements, envelope delay	Voice grade, to 2.8 kHz	— — —
Line requirements, impedance	Voice grade, to 2.8 kHz	135 ohms
Line requirements, signal to steady noise	Voice grade, to 2.8 kHz	— — —
Line requirements, signal to impulse noise	Voice grade, to 2.8 kHz	— — —
Method of operation	2 wire	4 wire
Temperature and humidity limits	+40 to +120 deg F	— — —
Power requirements	120 volts, 15 watts	140 watts
Dimensions and weight	11″ x 5½″ x 10″, 15 lb	31″ x 26½″ x 19″, 200 lb
Digital or analog	Digital	Digital



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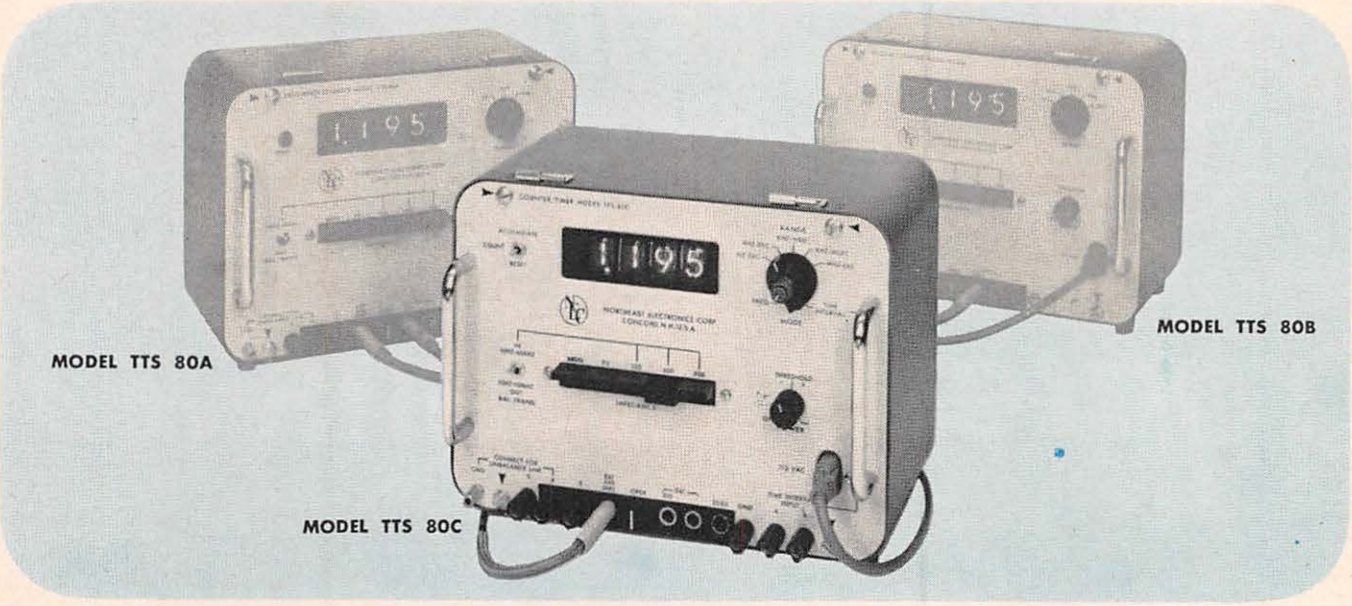

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Maximum Resolution	0.1 Hz			
Time Base	Power Line 60 Hz* (50 Hz available on special order)	Quartz Crystal in Temperature Stabilized Oven ≤ ±2 PPM/WK Aging Rate		
Counts Time Interval	No		Yes Maximum Display 999.9 sec Maximum Resolution 10 μsec	
Sensitivity	−40 dBm to 100 kHz −20 dBm to 10MHz Front Panel Adjustable Threshold Control			
Input Characteristics	Balanced. Bridging (100 KΩ), Terminate 75,135, 600, 900 Ω (±10%). Switchable Input Transformer for High Longitudinal Noise Rejection			
External Recorder Output	BCD 8421 Code Approx. 3 volts peak. Load Resistance >1 K Print Command Approx. 3 volts peak. Load Resistance >5 K			
Accuracy	±1 Count ± Time Base Accuracy			
Input Terminals	Jacks for 310, 241, 358A Plugs T, R, S, and GND Binding Posts		Time Interval A&B Binding Posts GND	
Power Requirements	117 VAC ±10% 60 Hz Approx. 10 watts	117 VAC ±10% 60 Hz Approx {12 Watts Cont. 22 Watts Oven On		
Dimensions	11" w x 8" h x 8⅝" d 759 cubic inches			5¼" h x 19" w x 6" d
Weight	12.5 lbs.	13.5 lbs.		12 lbs.

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Circle 16 on reader service card on page 78

How to protect against surges

By Fred A. Kahl
Sales Manager
Joslyn Electronic Systems

In the old days, the only type of transient that concerned the railroads was the one with his belongings tied in a bundle at the end of a stick and several days growth of beard on his chin. Now, with the advent of sophisticated solid-state electronic equipment for signaling and communications networks, a new and more serious kind of transient has come on the scene—the electrical overvoltage transient or surge.

When a transient is allowed to enter the signaling and communications circuitry, the result can be malfunctioning or completely destroyed electronics. As a result, rolling stock may be damaged, schedules disrupted, excessive wear incurred on the road bed, etc.

No true cost figures are available as to how much revenue is lost by the railroads each year due to transients. However, it is conservatively estimated that at least one half of the false restrictive failures that the industry averages each year are due to transients. The author will let the reader assign what he considers to be a representative cost per false restrictive failure. But, whatever the cost arrived at, it is a needless expense . . . and worse yet, represents a drain on profit dollars.

The incidence of transients depends upon the total electrical environment, both natural and man-made. In the natural environment, the most striking example of a transient is lightning. Along with lightning, associated phenomena include lightning surges and reflected components, whose magnitude is less, but whose destructive force greatly exceeds the capacity of semiconductor devices. Electrostatic charges due to atmospheric potentials can induce up to thousands of volts in transmission lines.

Man has created transient problems which surpass in magnitude and frequency even nature's best efforts. EMP, the nuclear electromagnetic effect, results in the transfer of electrical energy in billions of joules over an area of square miles. But there are many less dramatic ways in which man disrupts his electrical control and communications networks. Switching surges, as is found in the operation of locomotives, may generate transients of severe initial wave front (10,000 volts or more) with resultant power follow of several coulombs. Induced surges from paralleling power lines, motor starters, and switching transients rebound through electrical circuitry causing sparkovers and short circuits. Expensive and delicate circuitry then becomes nothing more than elaborate short circuit paths.

Transient difficulties arise in a multitude of locations within the railroad electrical complex. Directly coupled surges occur on the right-of-way as a result of lightning strikes or electrostatic charge accumulation. Magnetically coupled effects occur from switching transients on parallel power lines. Surge damage is caused within a locomotive by traction motors, generators, or solenoids.

The major damaging force of transients is in their current characteristics rather than in the high potentials associated with such discharges. Of all the different types of transients, lightning and switching surges are probably the most common troublemakers; and of these two, lightning has by far the highest current characteristics. A lightning strike generally is made up of three stroke currents, or components—the first rising from zero to 100,000 amp in five microseconds; the second rising to 2,000 amp within five milliseconds from the beginning of the first component and with a total charge transfer in excess of 20 coulombs; and the third component consisting of a charge of at least 200 coulombs for a duration of two seconds or less.

In addition, power transmission line disconnect and capacitor switching have caused transients of 3,500 volts or greater with durations on the order of milliseconds to be measured on line wires.

There are numerous devices on the

(Please turn to page 48)

Figure 1. SOURCES OF TRANSIENTS AND EQUIPMENT THEY AFFECT

NATURAL SOURCES

- Lightning-direct or indirect strike induced or conducted
- Aurora
- Corona
- Electrostatic
- Radiation
- Ionization

MAN-MADE SOURCES

- Switching
- Arc Welding
- Contact with foreign circuits
- Loss of Neutral-to-ground connection
- Capacitive discharge of long cables
- Conduction, induction, radiation
- EMP, dynamite explosion
- Fluorescent lights
- Motor starting
- Fuse blowing
- Breakers opening
- Corona
- Electrostatic
- Reflection waves
- Generator overspeed
- Generator hunting
- Harmonic overvoltage
- System faults
- Restriking of breakers, arresters, cutouts
- Low-level spikes undetected by arresters

EQUIPMENT

- Automatic car identification (ACI)
- Centralized traffic control (CTC)
- Track overlay circuit (AFO)
- Hotbox detector (HBD)
- Frequency shift keyer (FSK)
- Carrier systems
- Diesel generators
- Radio controlled locomotive radios
- Battery rectifier circuits
- Grade crossing predictors
- Multiple carrier circuits
- Microwave control systems

SURGE PROTECTION

(Continued from page 47)

market today that aim at the elimination of transient damage. Typical examples are filters, selenium rectifiers, Zener diodes, silicon controlled rectifiers (SCR's), carbon gaps, relays, fuses, circuit breakers, and spark gaps. Most of these components, while helpful, are often limited in their energy handling capability and are themselves subject to damage.

Table I analyzes each in terms of speed of response, sensitivity, energy handling capability, and stability.

From this analysis emerges a very significant fact: the properly engineered, hermetically sealed, gas-filled spark gap is the most versatile and effective arresting element. Here is how a typical spark gap works.

Depending upon gas-pressure, type of gas, electrode spacing, and electrode material and shape, the discharge in gaseous gaps will start with the application of a voltage higher than the breakdown threshold. The arc begins with barely measurable currents of a few picoamperes. Then, within the first few nanoseconds, several streamers appear with current flow at several microamperes. Some of the streamers cross the gap, and others form avalanche areas. During the avalanche period, current will increase to several milliamperes and the relatively high gas pressure will support further formation and spread of avalanche regions forming a conductive path within nanoseconds.

By now the current has reached several amperes, the gases have been highly ionized, the temperature of the gas has increased considerably and the injection of vaporized metal particles from the electrodes begins. The metal vapors increase the conductivity of the region between the electrodes with explosive velocity and, providing that the current is not limited or the energy of the source dissipated, a fully conducting arc will form within nanoseconds. The current then reaches several hundred amperes and within one or two microseconds many kiloamperes will be conducted through the gap. Since an arc has negative resistance or negative impedance characteristics, it has a tendency to conduct all the current which the source can supply.

After ignition, the voltage appearing across the gap drops to a low value, in the order of 40 volts. Like a fluorescent lamp, the gas continues to conduct after ignition, so long as the source voltage is higher than the arc-extinguishing voltage. It might be assumed that a neon tube could be used as a simple gas-filled protective device, but the low gas pressure, spacing and size of electrodes would limit its usefulness. Most small-size neon tubes are damaged by currents of a few amperes if their duration exceeds several milliseconds.

Spark gaps by themselves, though, cannot handle all of the possible transient situations to be encountered in the railroad environment. The most effective means of coping with surges in any eventuality is to prepackage the spark gap with a semiconductor component to form a surge protector. These multistage protectors may then be used singly or in combination with other protectors to form a surge protection network.

Each protector is capable of diverting high energies as well as lesser transients that exceed the equipment maximum surge level. Each is a passive system that requires no external power. Resetting is automatic.

Joslyn has developed three families of surge protectors: AC protectors (both single phase, 60 Hz and three

Table I. Basic Circuit Protecting Elements

Device	Speed of response	Protective Level (Sensitivity)	Energy Handling Capability	Stability	Comments
Hermetic, Gas-filled Spark Gap	Very Fast (nanoseconds	Good	High	Excellent	Response time excellent (nanoseconds), high energy handling when so constructed, low-voltage ionization levels, versatile, self-quenching, self-restoring, long life, maintenance free.
Air Gap	Fast	Poor	High	Poor	Highly unstable and vulnerable to changes in environmental conditions, will not divert transients under 600 v which will destroy solid-state equipment, requires maintenance.
Surge Relay	Slow	Good	High	Good	Good in almost all areas except speed of response—their millisecond response can't prevent the microsecond death of transistors, requires maintenance, bulky.
Carbon Gap	Fast	Poor	High	Poor	Fairly fast response, but not completely self-restoring (in case of high energy transients), ionization level too high to protect semiconductors, noisy in operation, requires maintenance.
Selenium rectifiers, RC networks, Zener diodes, silicon diodes, silicon controlled rectifiers	Fast	Very Good	Low	Very Good	Fast response, but seriously limited in energy handling capability—will not protect equipment from external transients such as lightning or induction from power lines, require replacement.
Circuit Breakers	Very Slow	Fair	High	Fair	Very slow, require maintenance, bulky.
Fuses	Very Slow	Good	High	Fair	Relatively slow, require replacement.

phase, 60 Hz), DC protectors, and communication and signal protectors. They are delivered ready for connection. They are normally supplied with mounting feet and may be operated from −40 deg. F. to +160 deg F.

Inherent features that assure continued protection include:

(1) Response time fast enough to prevent damage to solid-state devices.

(2) Large energy handling capability combined with low-level clamping for positive protection.

(3) No detectable deterioration in operating performance within its rating —that is, unlimited life.

(4) Further, these protectors operate unattended in the field requiring no maintenance.

Joslyn 1000 series DC protectors are a good choice for use on board diesel-electric locomotives where inductive switching occurs and where equipment must withstand vibration and heat. They may be used to protect all of the solid-state equipment on board the locomotive, including radio control.

The need for filters, circuit rearrangements, and special push-to-start switches normally used for protection purposes is completely eliminated by installing these protectors.

In operation, the DC protectors employ a silicon controlled rectifier to provide the first stage of protection. A hermetically sealed spark gap handles the high energy transients and surges. As the wave front of the transient appears at the terminals of the protector, its overvoltage characteristic is immediately sensed by the SCR which electronically forms a short circuit path across the power input leads. This is not a true short circuit of zero resistance, but rather a short circuit which has the equivalent resistance of the conductivity of the SCR. Immediately after the SCR fires, the output line voltage drops down to approximately 80% or 90% of the input terminal DC voltage. Also, when the SCR fires, the DC power source provides "power-follow."

The characteristics of the SCR are such that, unless some means is provided to interrupt this current flow, the SCR will conduct on a continuous basis. To interrupt this current flow and restore the circuit to normal, a vacuum contactor is used. Operating immediately when the current flows through the activating magnet coil, the contact mechanism opens the circuit carrying the power-follow. This whole operation is accomplished in milliseconds: the contacts open, the power-follow ceases, the SCR is restored to normal, and the vacuum contact switch closes restoring the SCR to the circuit.

The speed with which this device restores itself is such that within microseconds the circuit is completely restored to normal. In the event that the transient is of such amplitude that it would damage the SCR, the hermetically sealed spark gap fires. The spark gap is capable of repeated operation at 2,000 volts, 5,000 amp, on a 10 x 20 microsecond waveshape. The circuit is fully protected at all times during the above operations.

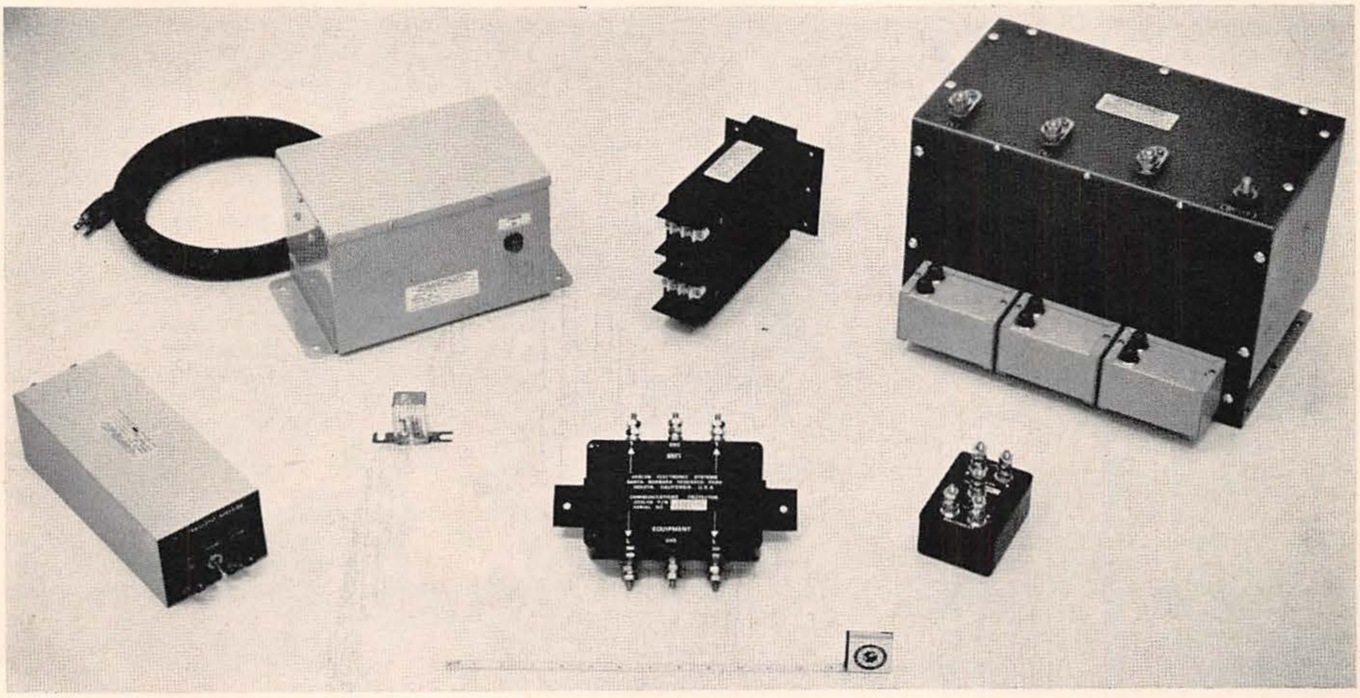
The second group of protective units is the 1200 and 1400 series of AC protectors. Here again, the requirements have been met for a device that is completely self-contained, requires no power for its own operation, and allows virtually uninterrupted operation of the circuit being protected.

The 1200 and 1400 series may be used very effectively to prevent overvoltage transients and surges which occur on AC power lines from entering battery rectifiers, solid-state power supplies, and all AC powered circuits.

Normal protection provided by the 1200 and 1400 series is line-to-line, inasmuch as one side of the AC circuit is usually grounded. In some instances, line-to-line and line-to-ground protection is required on an ungrounded system. This is essentially provided by ganging the appropriate number of protecting devices into a common mounting box, and providing a ground terminal on the box itself.

The operation of the 1200 and 1400 series of protectors is performed basically by a Joslyn-designed spark gap. This device is extremely rugged, very fast acting, and capable of bypassing large amounts of transient energy and 60 Hz power-follow.

When a transient with a peak value exceeding the preset clamping level of the spark gap appears at the input of the protector, it is instantly bypassed through the protecting circuit. The protected equipment will see a voltage drop while a spark gap is performing its function of transient protection. At



Surge protectors: (back row, left-to-right) 1201-02 single-phase AC protector; 1601-01 communications and signal protector; 1414-06 3-phase AC protector. (front row, left-to-right) 1001-01 DC protector; 2301-01 Visi-Guard; 1625-01 C&S protector; 1635-01 C&S protector.

the same time, the gap is also required to handle the available current of the power-follow phenomena. The design of this gas-filled spark gap is such that, after being triggered, it is self-extinguishing at the end of the first current zero. This means that the power will be restored to the AC circuit with absolute smoothness.

Probably the most universal protector used in railroading is the Joslyn 1600 series communications and signal protector. It will give complete protection against transients which threaten either the input or output circuits of CTC systems, AFO circuits, carrier communication networks, etc. A variety of line impedance values and DBM or absolute voltage readings are available. Complete protection is provided line-to-ground and line-to-line.

Typical output voltage limitation of the model 1601-01 is 0.5 volts maximum amplitude line-to-line, and 250 volts maximum amplitude line-to-ground. When the surge or transient has been dissipated, the protector resets itself immediately, and is ready to then handle another transient. The self-clearing time for the 1601 is two to three microseconds. At no time is the circuit without protection.

In operation, the 1600 series performs electrically like an absolute limiter on the circuit it is protecting. Any over-voltage applied to the circuit is held to an absolute listed value of ±10%. Other models have higher absolute voltage ratings.

View from the Crossarm

Seated around an oval table are a Union Official, a Signal Engineer, a railroad Personnel Officer and a General Manager. They are discussing the latest union notice for pay raises for signalmen.

Union Official: We're trying to bring our pay scales in line with men having comparable skills and work assignments in industries other than railroading. Our men are receiving far less pay than what they could obtain in other industries.

Signal Engineer: I've heard this one before. In fact, that's the same old record you've been playing for several years. You know and I know that some of your men are not worth a raise. If we could replace some of them with men having modern-day skills, we would.

Union Official: Don't blame me. We've tried to work out a training program with you, but you want the men to do all the work. You want them to study on their own time. And if you could get away with it, you wouldn't give the trained man any more money.

General Manager: We won't get anywhere with this kind of argument. But I do think you've both hit on something that we can get mutual agreement, namely job classifications based upon skills.

Personnel Officer: Now we're getting somewhere. How about a plan to give all our signalmen tests to determine their levels of education, training and skills?

General Manager: I think you're leading up to something like civil service. And if it is, I'm for it.

Personnel Officer: That's just what I mean. We could make use of educational testing consultants. Possibly signal engineers from the manufacturers to give technical assistance would be helpful. We could set up standards for educational, experience and skill levels for various types of job classifications. A training program could be worked out with accredited technical or trade schools.

General Manager: It seems to me that we could work out an agreement with the union to make such a plan successful. Certainly, we could work out an arrangement for home study, and on-the job training including tuition refunds for successful students.

Signal Engineer: Sounds fine in theory, but don't forget we'd have to have on-the-job testing to be sure the men really learned what was in the books.

Union Official: In general, I'll go along with what you've said so far. But I would certainly want seniority to play its role. Also, if a man passed one of these training programs or qualified for the next higher rating, then I would want that man promoted immediately, and he better have a raise in pay to compensate him for his greater skills.

General Manager: Naturally, a man who successfully completes a phase of training (passing examinations, both oral, written and field testing) would be automatically promoted to the next higher technician's grade. And his pay would be raised to his higher rating.

Personnel Officer: As for seniority, it would seem logical that in the case of two men holding the same job classification, the man with more seniority would be put into a job requiring that skill. Otherwise, the skill factor determines. By promoting men into higher rated job classifications upon passing examinations, it would give you a pretty good pool of skilled men to move around to fit the work to be done.

Signal Engineer: That's what I need—a pool of skilled men. Right now, we're short of skilled men. We're about 18 months to 2 years behind on our construction work because we don't have enough skilled men to install the equipment. And we're just about holding our own on trouble shooting. We could certainly use a skilled force for preventive maintenance.

Union Official: This sounds almost too good to be true, but there are many details to be worked out.

Signal Engineer: Not only that, but it's going to cost plenty of money.

General Manager: Maybe so, but I think we in management have "seen the light." For example, when we rent or buy a computer, the manufacturer tells us he must be able to use it for at least 8 hours each day for diagnostic tests, preventive maintenance, etc. We don't argue, we accept it. But yet, we have you install a computer-controlled retarder yard and expect it to work 24 hours daily, the year around, and with practically no maintenance forces. On this road, at least, we've come to recognize the importance of having skilled maintenance personnel. They don't cost, they pay for themselves. Of course, it will take a couple of nickels to set up this job rating classification plan with its associated training program, but it will more than pay for itself in the long run. Look at how many hotshot freight trains we're running. Just let them be delayed in a yard or out on the line for an hour while you hunt for signal trouble. Train delays cost money, especially if connections are missed.

Personnel Officer: In summary, I guess we're agreed that we can work out a job classification plan for signalmen, with an associated training program. We'll call in outside consultants for testing, setting up training programs, and get this rolling. I assume that we'll meet from time to time as work progresses. In fact, we'd probably better consider ourselves a permanent committee to guide this venture.

Union Officer: Count me in.

Signal Engineer: Me too!

General Manager: Let's meet next week with definite written proposals as to how we should proceed.

NOTE: This meeting, unfortunately, is an imaginary one. But, it could take place, and it seems to me that it should take place, and soon!

Bob McKnight

RAILWAY SIGNAL + COMMUNICATION DEPT.
SUPERVISOR

"I'm sorry, but we cannot retire you until we find a signal and communications man to take your place."

Letters to the Editor

Dear Editor:

In one of your Editor's Corner columns you said you wanted feedback. Well, here it is.

Are you for or against signal and communications engineers and specifically the C&S Section, AAR? I can't tell. One month you praise efforts by C&S men, and a few months later you "give 'em hell," (Pardon my French). Seems to me you are more generous in your praise towards communications men. Incidentally, I head up a C&S department.

I know that some of my colleagues (and me included) have thought that Railway Signaling & Communications was our friend, but now we have doubts.

You have said you "like to stir up the animals". Haven't you ever heard that "honey catches more flies than vinegar"? The way you cover meetings makes me wonder if you've become just another newspaper reporter. You may take that as a compliment, but I say it with strong reservations. Seems to me some of your reports are trying to show us C&S men up in an unfavorable light. Sometimes I think you just sit down to your typewriter and say "Who'll I give hell to this month".

How about setting me straight, and a lot of other C&S men, too?

Name Withheld by Request

Dear Sir:

I thank you for giving me the opportunity to set the record straight concerning this magazine's editorial policies and my own views on communications and signaling men.

I am positively for C&S men and the C&S Section, AAR. Together we can progress and advance the interests of C&S men and the railway industry. Separately or working alone, we fail.

However, I feel that I am in a position to view conditions throughout the industry rather than seeing only what goes on in one railroad. From such a vantage point, I can often see (not the crystal ball type of sight) changes, trends or omens (if you will) of events that will affect C&S men. I had hoped and firmly believed that my criticisms were helpful, and I believe I have made suggested solutions to these comments.

I am only too quick to point out good actions when I observe them. But as a friend I hope I can give friendly advice. One of the problems is that one's writings are sometimes misunderstood. It is always unfortunate and sometimes dangerous to "read between the lines". If you "read into" material something which is not actually written, you may misunderstand what the writer is telling you. Worse yet, is the fact that feelings may be hurt, friendships may weaken and a true communications gap may be created.

Conversation has a big advantage over writing. Talking to a person enables the talker to judge immediately the effects of his words. Further, he can explain what he means. There usually is no misunderstanding between conversationalists.

I can assure you that I try to say, as clearly as possible, what I mean in editorial comments, and in articles. So I give you this gentle reminder. Do not try to read something into the Editor's Corner that is not in the true or normal meaning of the words presented.

Railway Signaling & Communications' policy is to be an independent engineering journal reporting on developments in the communications and signal areas of railroading. We keep our opinions out of the articles. When we make opinion statements, we tell you so.

We are a friend, but we are not trying to win a popularity contest. We hope, by pointing out areas where improved relations can be made, that you will at least accept these criticisms as coming from one who has no axe to grind, unless it be to help you. We rise or fall on your success.

Our reason for commenting upon C&S men's actions, responsibilities and objectives is that we believe that the technology with which you are concerned is advancing so rapidly that your approach to your job is considerably different than it was, say 25 years ago.

A big change has been the introduction of the computer. More than anything else, the computer has brought top railroad management into closer contact and control with all phases of the business.

Also real-time computer operations are most dependent upon good communications. This brings the communications engineer directly into contact with top management as well as all departments of a railroad.

Additionally, the signal engineer through centralized dispatching, system-wide CTC, and automatic classification yards is becoming involved with computers, and directly with top management.

C&S men are no longer just true engineers running highly technical departments with little contact outside those departments.

I strongly believe that without C&S men and the C&S Section AAR's efforts, the advancements in railroad operations and management information flows would not be as highly successful as they are today.

Although I am not trying to win a popularity contest, I must say that when I offer praise for accomplishments or "spread a little honey", I am only trying to give praise where it is due. I am not trying to "butter someone up". Any praise in the Editor's Corner is offered sincerely and without strings or attachments.

Likewise, when I point out apparent faults or criticize, I am not doing so to cause "unfavorable light" to shine upon the individual or action. It is merely to point up a situation and I offer what I feel is a possible remedy.

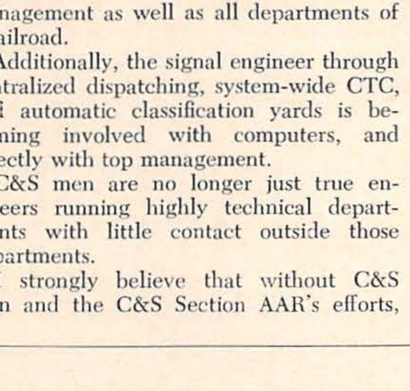
You mention our reporting methods. We report on meetings which are open. The annual meeting and the Sectional meetings of the C&S Section, IEEE meetings and the Data Systems Division AAR meetings are widely publicized. We and other magazines have alerted members to attend these meetings. These are not closed meetings. We report them as factually as we can. We have no bias. Our primary interest is to bring the report of the events, speeches, talks and discussion of the meeting to those readers who did not attend.

I must make it clear that the associations holding these meetings do not tell us what to report or how to report. They have been most cooperative in helping us to cover their meetings. But we do the reporting.

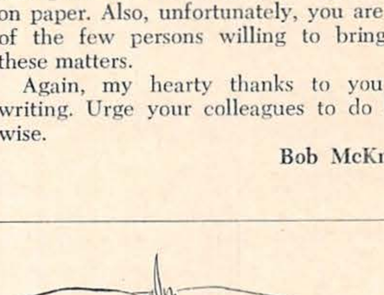
I am not a mind reader, but I hope I have been able to clarify my position for you, and by printing my remarks, hopefully will get my views across to our colleagues. One of the problems in this area is lack of communications to me or feedback. You, I thank for writing me. Unfortunately, you are almost alone in taking the time to set your thoughts down on paper. Also, unfortunately, you are one of the few persons willing to bring up these matters.

Again, my hearty thanks to you for writing. Urge your colleagues to do likewise.

Bob McKnight



"After spending years in railroading I'd think there wouldn't be anything left in it to exhaust you!"



"Why wait for the lights to quit flashing? The train has already passed."

Communication and Signal Section, AAR

1968 Meeting, Adolphus Hotel, Dallas, Texas

Tuesday, October 1, 1968

Meeting called to order 10:00 a.m. in Rose Room, 15th Floor
Address: T. M. Goodfellow, President, Association of American Railroads
Address: J. H. Brown, Assistant Vice-President, St. Louis-San Francisco
Report: Committee A—Outside Plant Facilities
Report: Committee B—Radio and Microwave Systems
Report: Committee C—Communications and Data Systems
Report: Committee D—Highway Grade Crossing Protection
Report: Committee E—Interlocking, Traffic Control and Block Signal Systems
Report: Committee F—Car and Engine Control Systems
Report: Committee G—Education and Training

Wednesday, October 2, 1968

Concurrent meetings called to order at 9:00 a.m.

Danish Room, 15th Floor

Introductions: J. N. Albertson, Second Vice Chairman

Paper: "Transient Protection for Signaling and Communication Equipment," by F. A. Kahl, Sales Manager, Joslyn Electronic Systems.

Paper: "Mobile Teleprinter in Railroad Application," by W. Borman, Engineering Manager, Motorola Communications & Electronics, Inc.

Coffee Break: 10:30 a.m.

Paper: "PCM—Initial Application at Western Union," by C. C. Batterson, Plant Transmission Engineer, Technical Facilities Department, and R. D. DeWitt, Manager Transmission Systems Engineering Planning, Western Union Telegraph Co.

Paper: "TOPS Data System," by J. N. Albertson, General Superintendent Communications—System, Southern Pacific Co.

Rose Room, 15th Floor

Introductions: H. R. Beck, First Vice-Chairman

Paper: "FM Tone Modulated Audio Track Circuits," by R. E. Harmon, Vice-President, Sales, Harmon Electronics, Inc.

Paper: "Pulse Modulated Track Circuit Control," by C. M. Hursh, Eastern Regional Manager, Marquardt Industrial Products Co.

Coffee Break: 10:30 a.m.

Paper: "Total Terminal Control," by C. F. Wert, Manager Railway Sales, and G. F. McGlumphy, Manager Operations Research, Signal and Communications Division, Westinghouse Air Brake Co.

Paper: "Digital System of Space Radio Control of Power Switches," by C. Shook, Section Manager, Product Engineering, General Railway Signal Co.

Thursday, October 3, 1968

Meeting called to order 9:00 a.m. in Rose Room 15th Floor

Paper: "Motor Switch 4-wire Switching," by E. H. Gatzert, Principal Engineer, Stromberg-Carlson Corp.

Paper: "Evolution of a Rapid Transit Command Center," by C. Kalkhof, Superintendent, Maintenance of Way, New York City Transit Authority.

Panel Discussion: Automatic Car Identification—J. N. Albertson, General Superintendent of Communication—System, Southern Pacific Co., Moderator; G. Pipas, Director of Communications, Illinois Central Railroad; and C. B. Kapsambelis, Manager of Systems Integration, Sylvania Electric Products Inc.

Remarks: R. M. Laurenson, Superintendent of Communications, St. Louis-San Francisco Railway, and Chairman, Communication & Signal Section, AAR.

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Railway Signal & Communications Suppliers Association, Inc.

Exhibitors (Booth numbers are in parenthesis).

Abex Corp. (56 and 57)
American Telephone & Telegraph Co. (21-23)
Anaconda Wire & Cable Co. (45 and 46)
Automatic Electric Co. (28 and 29)
Buckeye Telephone & Supply Co. (42)
Collins Radio Co. (5-7)
Cook Electric Co., Wirecom Division (72)
Cushman Electronics, Inc. (53)
Erico Products, Inc. (58-60)
ESB, Inc., Exide Industrial Division (81)
General Electric Co. (66)
General Electric Co., Specialty Control (67)
Goodyear Tire & Rubber Co. (26 and 27)
Graybar Electric Co. (39-40)
Gulton Industries, Inc. (68 and 69)
Harmon Electronics, Inc. (76 and 77)
ITT Telecommunications (54 and 55)
ITT Wire and Cable Division (32)
Johnson Rubber Co. (41)
Joslyn Electronic Systems (49)
Kerite Co. (15 and 16)
Lenkurt Electric Co., Inc. (36 and 37)
LaMarche Mfg. Co. (65)
3M Company (48)
M. & M. Contracting Co. (64)
Marquardt Industrial Products Co. (73-75)
Motorola Communications & Electronics, Inc. (8-10)
Nife, Inc. (50)
Permacrete Products Corp. (25)
Portec, Inc., Poor & Co. (24)
Puleo Electronics, Inc. (43)
Pulse Communications, Inc. (33)
Quindar Electronics, Inc. (63)
Radio Corp. of America (70 and 71)
RFL Industries, Inc. (52)
Railroad Accessories Corp. (61 and 62)
Rails Co. (4)
Rohn Systems, Inc. (30 and 31)
Sangamo Electric Co. (44)
Secode Electronics (80)
Servo Corp. of America (82 and 83)
Simplex Wire & Cable Co. (38)
Singer Co., Metrics Division (17)
Stromberg-Carlson Corp. (11-14)
Sylvania Electric Products, Inc. (34 and 35)
Superior Continental Corp. (78 and 79)
Vapor Corp. (47)
WABCO, Signal and Communications Division (1-3)
Western-Cullen Division, WRRS, Federal Sign & Signal Corp. (18-20)
Wheel Checkers (51)

Railway Cybernetics

French National Railways have made CTC installations whereby the dispatcher may store various controls to provide automatic operation of switches and signals at passing sidings. One such installation is on a 63-mile, single-track line from Dole to Vallorbe. According to SNCF chief engineers, C. Laurent and M. Laplaiche, the CTC territory includes a number of stations, each one being provided with one "through" and one passing track, on which the safe operation of trains is ensured by electric interlocking devices connected with track circuits; these equipments are remote-controlled from Dijon by the dispatcher in charge of this line which is in eastern France.

All the stations along the line have a similar layout and, in each one of them, the following operations can be performed: (a) through running of trains, (b) crossing of two trains, (c) overtaking of one train by another.

For each one of these stations, and in addition to the conventional push-and-pull button desk and visual control panel, the dispatcher makes use of a device which allows him to store manually in advance four of the above-mentioned operation (a), (b) and (c) at one time, and in the order he thinks they will take place in each station concerned. These operations will then follow one another automatically, as far as the control of the switches and signals governing the train movements are concerned.

It was because so many "orders" could be stored all along the line that its entire control could be entrusted to one dispatcher only, with all the additional advantages that are besides afforded by such a system, such as:

(1) savings in manpower,
(2) fluent operation of the traffic
(3) increased capacity of the line, and
(4) prompt and efficient corrective action in case of emergency.

Speaking at the Montreal cybernetics meeting, Laurent and Laplaiche described a second installation of automatic CTC control at LaRoche-de-Glun. Here the track layout consists of one "up" and one "down" track, as on any double-track line, between which a siding track has been laid down where trains can enter from both ends over facing point switches, and which can accommodate the full length of a train.

The automatic block system equips the whole section; its switches and signals being all remotely controlled by the line dispatcher at Valence, 6 miles farther.

A very large number of trains run on this line, one of which has to be held from time to time on this siding to let faster trains go by. Let N be the running position of said train in the operating schedule.

Should no special facilities be provided for the dispatcher, and should he only have no other route-setting possibilities at his disposal than those given by French CTC controls of conventional design, he would be compelled to wait until train N-2 has cleared the entry switch to the siding track before he could pre-set the route of train N to this siding (the through route for train N-1 having been set), and then pre-set again the through route for train N + 1.

In view of the fact that the dispatcher has other duties to perform besides the control of train routes, the period of time he normally requires for such control might in consequence be so reduced as to entail possible stoppage or misroutings of trains.

However, the dispatcher can preset four "down" train routes and six "up" routes. The routes thus set can be either the through route, or the entry to, or finally the exit from the siding track.

Besides, the device in service at LaRoche-de-Glun has a feature of its own of special interest: the general operating rule is that trains normally run through on the main tracks, whereas movements to and from the siding are exceptional.

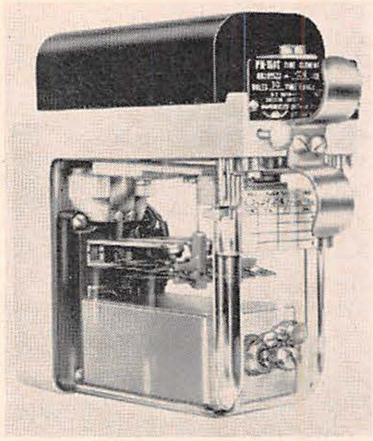
As a result of this, the pre-setting of through movements in the machine is performed automatically. Thus, in the "down" direction for instance, four successive through routes are at all times recorded.

When a train passes, these four routes shift up by one step and a newly set route appears on the diagram, all these operations being automatic.

When a dispatcher needs to hold a train on the siding, he must wait until said train is included in the first four movements to come along; when so, the operator can, at will, divert to this siding by a manual operation the through route already stored, and which corresponds to the actual position of that train in the aforesaid group of four trains.

This device makes it possible to minimize and considerably simplify the dispatcher's control action, with the corresponding simplification of this part of his duties in favor of the others.

Product News

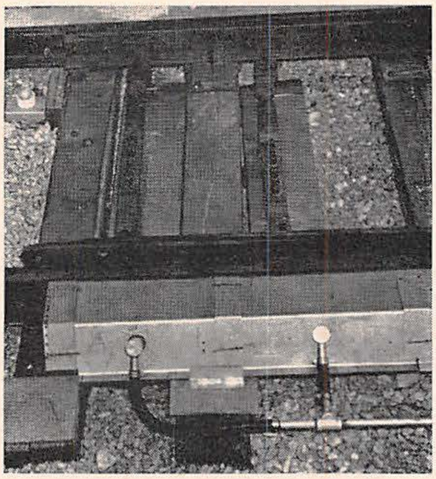


Timing Relay

A new solid state, time element relay designated the style PN-150T, is basically a style PH-150B, with an integral solid state delay unit which can be adjusted from outside the relay to provide a vitally safe pick-up time delay.

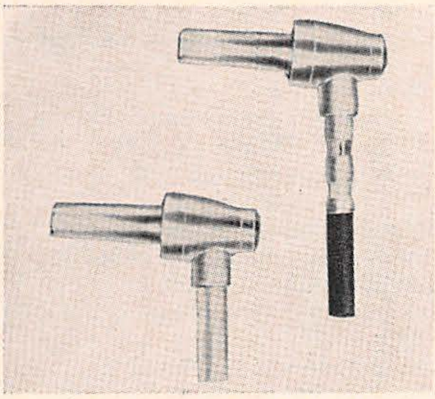
This new relay is applicable in circuits where the style PT-250 time element is used, yet requires only one-half the mounting width. The relay occupies only 2.5" of rack width and is indexed to fit the basic mounting base used for all style PN-150 relays.

The PN-150T is magnetically and electrostatically shielded, and has internal devices to minimize the effect that any external surges might have on the time element. At rated input volts the relay power input is 0.3 to 0.4 watt while timing, and 0.4 to 0.5 watt with the relay picked up. *Signal & Communications Division, WABCO. Circle 101 on Reader Service Coupon.*



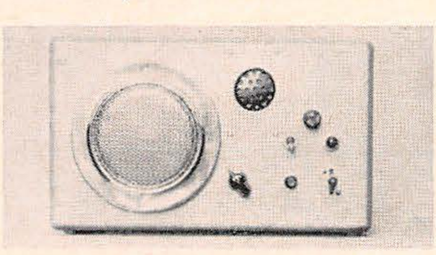
Rod Heater

The switch rod heater is designed to increase switch heating efficiency by keeping switch rods movable when packed ice or snow build-up is followed by a quick freeze Heat is sent directly across the switch rod, and enough is radiated to prevent water accumulation that could cause freeze-ups. The heater may be installed separately, or integrated with the Sno Gard system, and can be fired manually or automatically. *Vapor Corp. Circle 102 on Reader Service Coupon.*



Rail Bond Connector

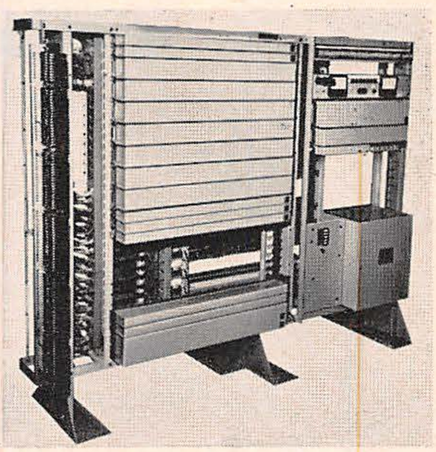
An improved rail bond connector for making track circuit connections is called the type S-TNS. The new design connector has been reinforced by the addition of a steel collar around the copper connector sleeve. The new connector takes USS type S-8 strand, which is inserted into the connector sleeve and locked by a crimping tool. *U.S. Steel Corp. Circle 103 on Reader Service Coupon.*



Intercom

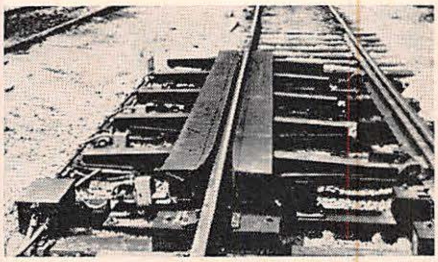
Two new solid state intercom desk loudspeakers, the CDX-301 and CEX-302 are designed for use for 600 ohm lines. They have their own power supplies and the only external connections required are Line and AC. The on-off switch, indicator light, and volume control are located on the face of the panel of both units. The CDX-302 panel has switches for push-to-talk and for ringing power to be placed on the line. They measure 5¾" wide, 7½" high and 12¼" long. *Western Railroad Supply Co. Circle 104 on Reader Service Coupon.*

● DATA TRANSMISSION: A new booklet, "Applications of High Speed Data Transmission", describes three systems in detail and outlines a three channel approach for supervisory control, data accumulation, computer linkage and digital telemetering. Technical data summaries are included. Model 2056 is an asynchronous channel in which two or three state data streams may be transmitted. The model 3227 is a coherent channel in which two state data streams may be transmitted along with and in synchronism with 50% clock pulse. The model 4000 is a synchronous channel in which the clock information is taken from the data set at both ends. *RFL Industries Inc. Circle 105 on Reader Service Coupon.*



Dial System

A new low cost, off-the-shelf, dial system now ready for use by railroads provides the nerve center for a communication operation of 100 lines and 15 links including as many as 10 trunk lines. Two trunk routes are provided and for each trunk not equipped, one additional station line is available. Although the system is physically small, it provides operating features usually found only in larger systems. Executive right-of-way, frequency selective ringing and plug-in off-the-shelf additions are standard features. The XY universal switch provides connection to any of 100 circuits. Circuit plates are complete units ready to plug-in for immediate operation. *Stromberg-Carlson Corp. Circle 106 on Reader Service Coupon.*



Retarder

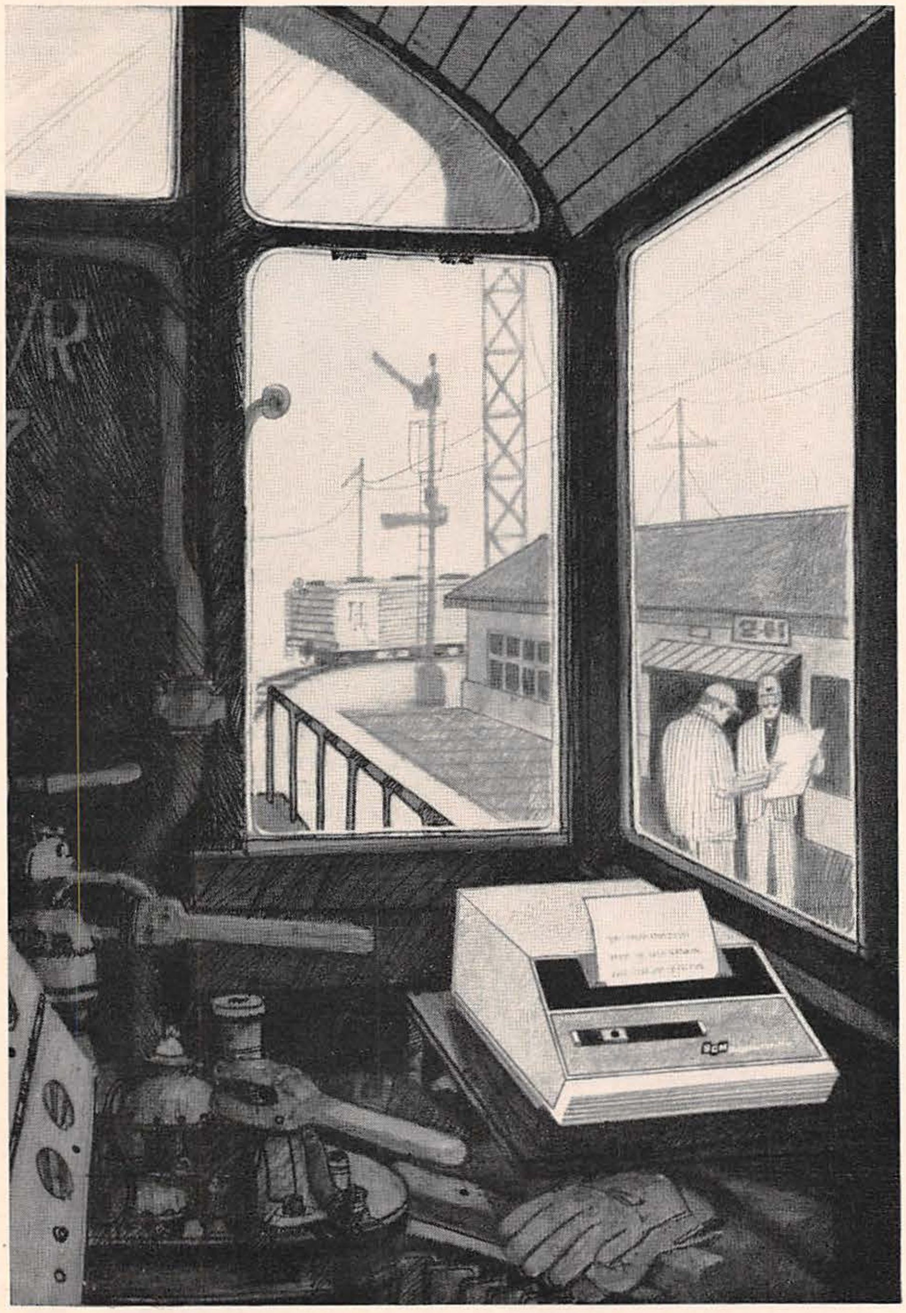
A new adaption of the standard model 50B retard-all retarder designated the Model 50B1 is a weight proportional retarder for handling 160 ton cars and has essentially the same appearance as the 50B, but is operated by a captive supply of nitrogen gas in areas where an air supply is not readily available. It is designed for use in medium density yards. WABCO, *Signal & Communications Div. Circle 107 on Reader Service Coupon.*

● PRIMARY BATTERY: Bulletin 1167 describes 2-ANS primary batteries that can provide power for up to a full year's

(Please turn to page 56)

Get the message even when you leave your cab – because it's printed!

The new Kleinschmidt Telescripter,™ first radio printer designed for railroads. Compact, plug-in, static-free.



Step away from your engine with a Kleinschmidt Telescripter printer in the cab and you don't have to worry. When you come back, you'll find all your calls waiting. *Printed.*

With a Telescripter printer at work, a busy train crew can concentrate on moving freight and let the machine take the messages.

A Telescripter prints-out complicated instructions in seconds, even when the train is in motion. Time designations. Track numbers. Car numbers. Freight sequence. Everything the crew needs to know is there, error-free, on paper.

In a caboose, a Telescripter printer gives the crew a hard-copy record of all destinations and orders automatically. So there can be no misunderstanding.

A Telescripter train unit plugs easily into any two-way radio. And because the messages are printed, they're always free of static and interference.

Most important, the Telescripter printer is designed with Kleinschmidt quality for extra reliability and sure performance.

For full details on the amazing new Kleinschmidt Telescripter printer, write to Kleinschmidt, Division of SCM Corporation, Deerfield, Ill. 60015. Telephone 312-945-1000.

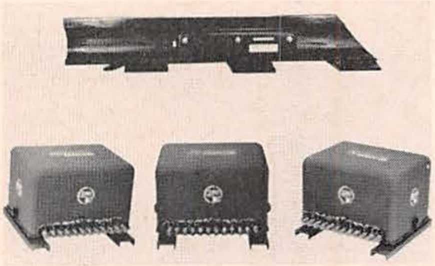
KLEINSCHMIDT
DIVISION OF SCM CORPORATION

SCM®

Circle 21 on reader service card on page 78

(Continued from page 54)

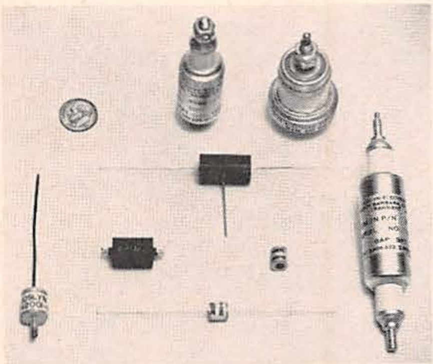
operation of electric switch lamps. Complete specifications are given, including a continuous-discharge test curve. *The Carbone Corp. Circle 108 on Reader Service Coupon.*



Crossing Control

A new system utilizing closed loop circuit principle has been designed to achieve simple, automatic and economical control of flashers and gates at railroad crossings in busy low-speed industrial switching areas. The system automatically determines train direction, provides timing and actuates the crossing control. Control action is triggered and timed when the train moves in the direction of the crossing. If the train stops, or moves away from the crossing, the control is timed out to terminate the signals.

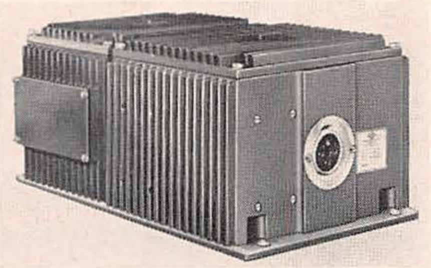
The system is designed to operate in conjunction with conventional island track ciruits. Circuit arrangement of the system components (transducers, directional analyzer unit, directional sensing unit, and downtime monitor) is designed to provide "fail-safe" operation of the crossing control. *Servo Corp. of America. Circle 109 on Reader Service Coupon.*



Spark Gaps

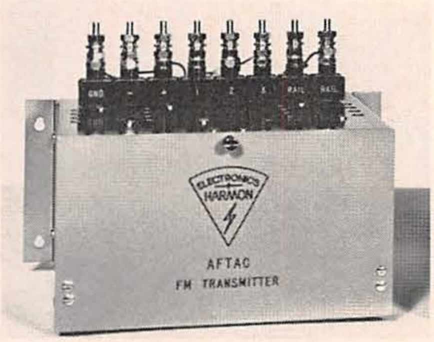
A new series of precision spark gaps have voltage breakdown capability ranging from 450 volts to 1500 volts. Types 2009-01 through 2009-04 are designed to protect sensitive components in applications such as communications systems, countermeasures devices, antenna networks, and modulators. They may also be used as electronic switches for pulsed energy systems. Sparkover occurs at the voltage breakdown point specified. No radioactive material is used in the devices.

Maximum surge current handling capability of the complete line ranges from 10,000 amp to 40,000 amp on a 10 x 20 microsecond wave shape. Included in the line are devices which employ the rotating arc principle to eliminate electrode deterioration, standard mounting units, and designs which provide direct lightning strike protection. *Joslyn Electronic Systems. Circle 110 on Reader Service Coupon.*



Converters

Static voltage converters, called Convertairs, are devices for changing 60-80 volts DC to regulated DC voltages for operating various devices including radio and train control equipment. Various outputs available are 13 volts DC with 9.5 amp or 33 volts DC with 3.5 amp. A dual Convertair provides 13 volts DC at 9.5 amp and 33 volts DC at 3.5 amp output. Another model with the 60-80 volts DC input is a dual unit providing 33 volts DC at 3.5 amp and 350 volts DC at 0.125 amp outputs. *Vapor Corp. Circle 111 on Reader Service Coupon.*



FM Track Circuit

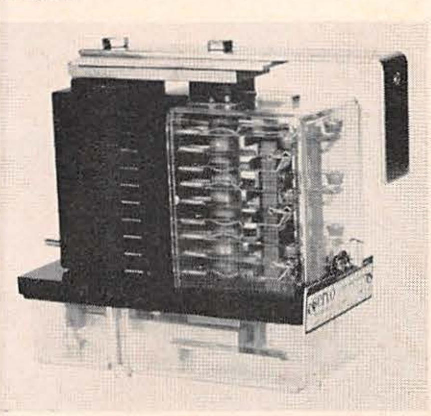
A new frequency modulated, tone modulated audio frequency train activated circuit has been developed for grade crossing protection or electric lock circuits where external interference may occur. Designed for circuits to ¾ mile the model 1111A has a power output of 1, 2 and 5 watt selective at an output impedance of 2 ohms. It is FM modulated for freedom from external AM or electrical interference. There are 23 carrier channels and 6 subtone channels. Shunting sensitivity—20 ft maximum, 5 ft or less receiver ring-by. Environmental stability is from −60° to +160°F. Modular printed circuit board construction is used in both transmitters and receivers. *Harmon Electronics Inc. Circle 112 on Reader Service Coupon.*

● BATTERIES: Latest performance data for high rate discharge nickel cadmium batteries is listed in a new four-page specifications bulletin. It covers pocket plate HI and HIP steel and plastic container batteries with nominal capacities from 8.5 through 150 ampere hours for plastic container cells and from 65 through 570 ampere hours for steel container cells. Data includes typical voltage current curves and charging data for applications ranging from six through 125 volts. *NIFE Inc. Circle 113 on Reader Service Coupon.*

Signal Bridge

A new long-span aluminum box truss signal bridge with galvanized tubular steel uprights has been developed to solve overtrack signal problems. They are available in 4 ft increments to 160 ft with heights to suit required specifications.

New galvanized steel cantilever type signal sign posts are also available for spans in 7 ft increments up to 35 ft wide, heights to meet specifications. *Western Railroad Supply Co. Circle 114 on Reader Service Coupon.*



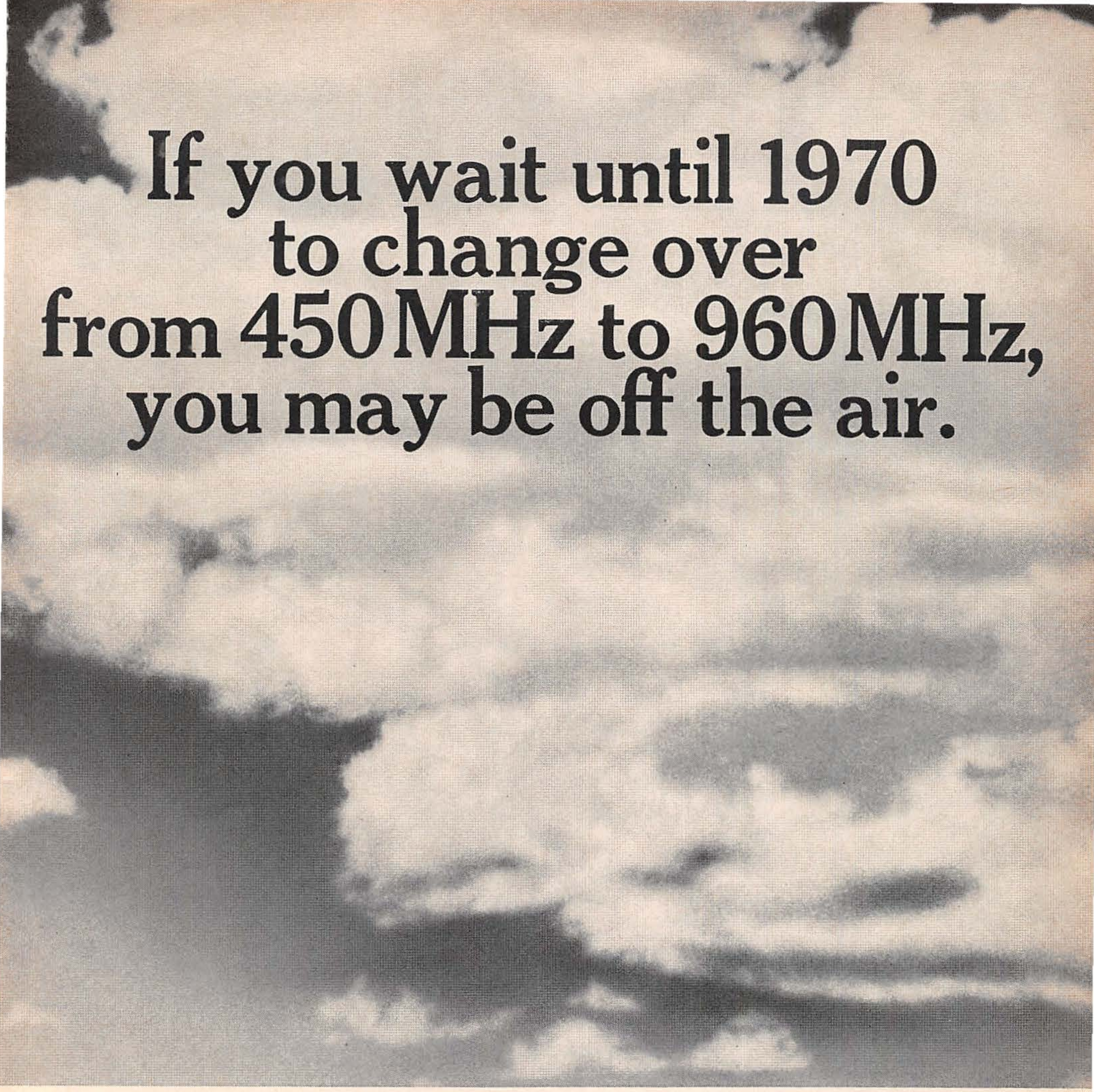
Plug-In Relay

The SS-100 relay is a new general purpose safety-type plug-in relay for vital circuit applications. It meets all of the requirements of the AAR specification covering relays of this class and can be equipped with a maximum of 6 front and 6 back dependent contacts. The relay is also available with 4 front and 4 back, or 2 front and 2 back dependent contacts. Front contacts are non-fusing silver to silver impregnated carbon and back contacts are bi-furcated silver to silver. Contacts are molded in phenolic plastic and can be individually applied or replaced as required. All contact parts are nickel plated. The contact fingers that enter the mounting base are rhodium plated.

Biased type, ordinary acting line and track relays can be furnished. Slow release line relays are also available. The mounting base is molded of phenolic. Contact members are formed from a single piece of phosphor bronze spring material. A test jack is provided in the mounting base. This permits the relay to be released from the front of the rack and enables coil energy to be monitored during periodic tests. *Servo Corp. of America. Circle 115 on Reader Service Coupon.*

● CONTROLLED LIGHTING: The basics of photocontrolled lighting and the ultimate in photocontrols for specification-grade lighting are described in bulletins which give electrical characteristics and

(Please turn to page 58)



If you wait until 1970 to change over from 450 MHz to 960 MHz, you may be off the air.

The new FCC rules drastically limit the areas where the 450-470 MHz band can be used for point-to-point communications—and give you a couple of years to make the changeover if you come under the new rules. But doesn't it make sense to change to 960 MHz now, before the rush is on? Particularly when you have available to you, from Cardion, the first solid-state, FCC type-accepted 952-960 MHz radio relay equipment in the industry.

Cardion's new equipment extends the state-of-the-art. You can get up to 5 separate voice channels, each with its own control circuit uplink and carrier-operated relay circuit downlink. You can get duplex operation over a single pair of radio frequencies with just one antenna and one transmission line. And you do get a built-in service channel, independent from multiplex equipment.

So why not go Cardion 960 *now?* That way you make sure you're not held up by any last minute delay in equipment . . . and you make sure you stay on the air.

Cardion COMMUNICATIONS
Formerly Budelman Electronics Corporation
A UNIT OF GENERAL SIGNAL CORPORATION

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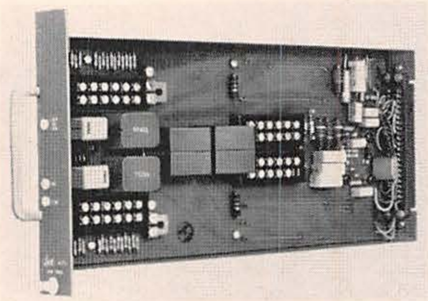
Circle 22 on reader service card on page 78

(Continued from page 56)

mechanicals and physical dimensions of photoelectric equipment that can be used to control lighting for such locations as yards, around terminals, piggyback ramps etc. *Precision Multiple Controls Inc. Circle 116 on Reader Service Coupon.*

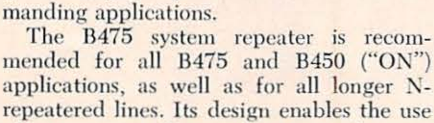


System Repeaters

The B410 and B475 system repeaters are now available to provide compatible state-of-the-art repeatering on modern "N" type systems. Two repeater amplifiers were developed for use with a common line-terminating unit. The two alternates are designated B410 ("N2") system repeater and the B475 ("N3") system repeater. Either may be used on any "N" compatible repeatered system but each has its particular application. The B410 system repeater gives adequate performance on less demanding applications.

The B475 system repeater is recommended for all B475 and B450 ("ON") applications, as well as for all longer N-repeatered lines. Its design enables the use of as many as 40 repeaters in tandem, on lines up to 200 miles in length. Stability is provided by silicon transistors that are less susceptible to fluctuations in ambient temperature. Installation, maintenance, and adjustment are made easier, and soldering is eliminated, because screwdriver adjustment is used for: internal adjustments in the field, receive span-pad-loss strapping—in 1 dB steps, through or looped power arrangements, voltage regulator strapping—which allows a single type of line-terminating unit to operate with either a HI-LO or a LO-HI repeater.

The B475 repeater uses four types of equalizers to normalize the frequency response irregularities of cable. *Lynch Communication Systems. Circle 117 on Reader Service Coupon.*



Optical Scanner

A new optical character scanning system reads both hand—and machine-printed characters and transfers the data directly to magnetic tape for input to computers. The OpScan 288 consists of two units. One transports the documents, scans them, and then stacks them. The other unit contains the logic circuitry needed to put the data from the documents onto magnetic tape.

The key to the reader's ability to interpret hand-printed characters is a special grid. Pre-printed on the document, the grid resembles a row of dominoes. A four-dot configuration in each square serves as both constraint and guide, aiding the writer to print the characters in the proper areas of each square. To make the hand-printed characters more legible, the grid squares are large enough for a letter considerably larger than a machine-printed letter. Each square measures three typewriter spaces, which makes the grid easily adaptable to data processing document design.

The machine-printed characters are in the ASA-A type font. Because machine-printed characters are smaller and do not require a grid, up to 80 characters can be accommodated on a single line. Both hand-printed and machine-printed characters can be placed on the same scanning line. In this case, the grids are imprinted only where handprinted characters are desired. The rest of the line is left clear for machine-printed characters. With its ability to read up to 80 characters to a scanning line, the OpScan 288 can handle information equal to the full data capacity of a standard punched card. Another feature is its ability to accept documents of from 2½" by 3½", to 4½" by 8½". The documents can be on paper ranging from 20 lb to tabulating card stock.

The basic reader scans single line documents. With a special option, however, the OpScan 288 can also read two and three lines on each document at reduced speeds. Singleline documents are read at 600 per min, two-line documents at 300 per min, and three-line documents at 200 per min. All characters, whether machine-printed or hand-printed, are optically broken into easily distinguishable component parts, then recorded on 556 CPI seven channel magnetic tape. The capability to record on 800 CPI nine channel tape can be supplied as an option.

The OpScan 288 is compatible with all major computer series. Among those it can work in conjunction with are: Honeywell 200, IBM 360, IBM 1401, NCR 315 and RCA Spectra 70. *Optical Scanning Corp. Circle 118 on Reader Service Coupon.*

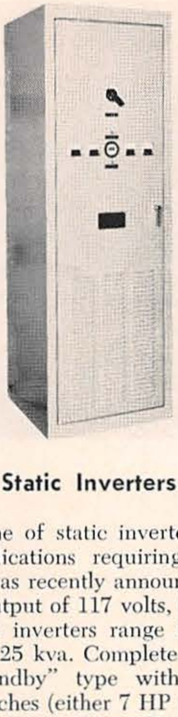
Telephone Sub-set

A new transistorized telephone sub-set is designed for use at stations on dispatcher, message and similar circuits where attenuation is high enough to make amplification necessary in both the transmitting and receiving conditions.

The CDX-101-A sub-set has a two-storage transistor amplifier, operating on a standard 4.5 volt transmitter battery. It is switched on by means of a relay, permitting use of the same amplifying equipment for both transmitting and receiving. The unit is designed to operate with the standard F-2 transmitter and HA-2 receiver capsules and may be substituted for a CEX-25, or other similar standard sub-set, or used with the standard three-wire desk stand, without additional equipment. *Western Railroad Supply Co. Circle 119 on Reader Service Coupon.*

Dragging Equipment Detector

A new bi-directional, self-restoring dragging equipment detector can be easily installed, and has a blade height adjustment to suit various rail sizes from 110 to 155 lb. The model 8100 is tie-top mounted with two supplied brackets. The detector blades can be easily and quickly replaced if damaged. The sensing and control mechanism is designed to eliminate "false alarms" caused by wind pressures. Centering torque of the detector can be preset before installation, and is adjustable from 100 lb to 800 lb. The torque adjustment and all internal components are sealed against dirt and moisture. *Servo Corp. of America. Circle 120 on Reader Service Coupon.*



Static Inverters

A new line of static inverters for those critical applications requiring continuous AC power was recently announced. With a sine wave output of 117 volts, 60 Hz single phase, these inverters range in capacities from 0.2 to 25 kva. Complete AC systems of the "standby" type with high-speed transfer switches (either 7 HP transfer time or no-break 30% voltage dip for ½ Hz), charger and nickel cadmium pocket plate batteries are available. A "no break" system is also available, where inverter continuously supplies the AC load through the charger during normal operation, or through the battery when commercial power fails. *NIFE Inc. Circle 121 on Reader Service Coupon.*

• TEST EQUIPMENT: Bulletin 2078 contains photographs and electrical characteristics of general service test equipment including vacuum tube voltmeters and volt-ohm-milliammeters. *Simpson Electric Co. Circle 122 on Reader Service Coupon.*

(Please turn to page 60)

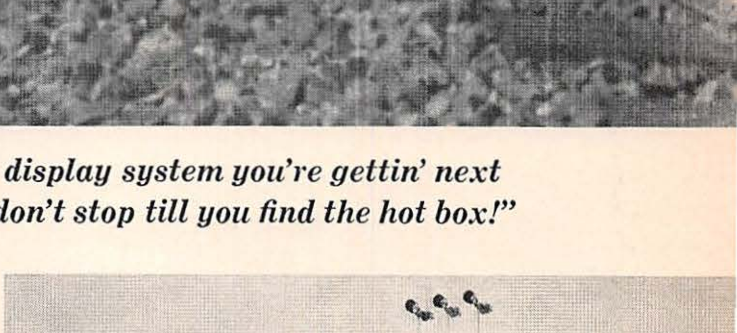
"Never you mind 'bout that new Servo display system you're gettin' next month—right now, start walkin' and don't stop till you find the hot box!"

EVEN without the guns pointed at him, our railroad friend's task of "walking the train" to find a hot journal box was not an enviable one. It certainly would have been simpler and quicker if he did have our new SERVOLARM® Trackside Hot Box Visual Display System.

Designed to operate with a standard SERVOSAFE® Hot Box Detector System, the SERVOLARM visually signals the presence of a hot journal box and also pinpoints its location by means of a digital readout axle count. SERVOLARM helps to eliminate train stops and crew delays. It simplifies and speeds up the entire hot box location procedure by directly notifying the crew via a trackside display board.

SERVOLARM can be quickly and easily installed with a minimum of construction equipment and labor, while eliminating long-distance wiring and extensive communication equipment costs. Compared to other, more complex methods of communication, SERVOLARM offers greater reliability and reduced maintenance.

Are you tired of looking for hot boxes the hard way? Take a look at SERVOLARM—just ask for Tech Data Publication 2013.



Bi-directional display board presents digital readout, showing axle count location of hot journal box. If no hot boxes are detected, display board reads "000". Flashing signal lamps on top indicate presence of hot box.

SERVO SYSTEM SERVICE—Servo Corporation of America backs up its railroad products with complete support and assistance—site survey, application engineering, detailed proposal, installation checkout, plus lifetime service and personnel training—all provided at no extra charge!

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111 new south road
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516-938-9700

MEMBER RPI

Circle 23 on reader service card on page 78

PRODUCT NEWS

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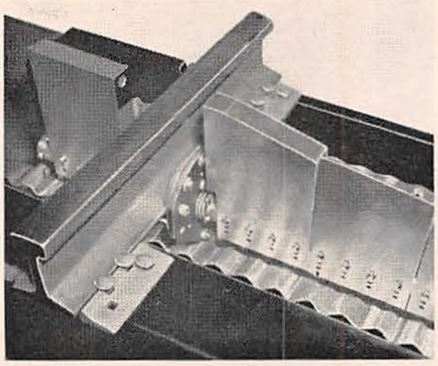


Dragging Equipment Detector

Scanning critical areas left open by other types of detectors is an important feature of a new dragging equipment detector. It features electronic circuits that are interlocked to differentiate between dragging equipment and wheels. The detector is attached directly to the rails by insulated clamps. When the rails are deflected by a train the detector will move with the rails. The detector is self-restoring and can be used for main line or yard service. Steel alloy plates are adjustable for height. Wheels that have moved in on the axle are also detected by the unit. *Wheel Checkers. Circle 123 on Reader Service Coupon.*

VAPOR
INVERTAIR

Inverter

A series of static inverters change direct current to alternating current. Known as Invertairs, the series is available with 36 volts DC input at 100 va to provide 60 Hz outputs at 110, 120 or 130 volts AC. Other models have input ranges of 32 or 64 volts DC with capacities of 300, 600, 2500 or 3500 va. All these 32 and 64 volt DC models provide an output of 115 volts AC at 60 Hz. *Vapor Corp. Circle 124 on Reader Service Coupon.*

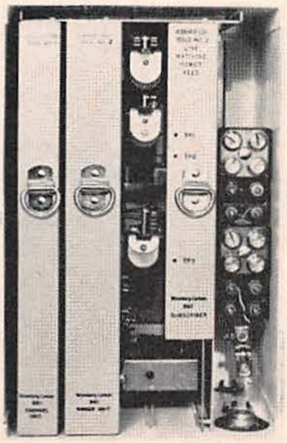
Crossing Package

A complete standard line of automatic highway grade crossing control packages have been designed for use with light weight gates or standard flashing light signals. Packages are also designed for the far-end of the approach track circuits. The type of warning device to be installed determines which control system is required, but is not included as part of the control package.

The control equipment is packaged for grade crossing operation, single or double track. If special circuits are required for switching, station stops etc., modifications can be provided. The control equipment is available in complete factory assembled housings, ready for installation upon delivery, or unassembled for assembly and wiring in the field.

A typical control package is designed to give adequate warning to highway vehicular traffic in advance of a train approaching from either direction. The economy control housing contains the following circuit features: Protection Control—designed on the fail-safe principle; Directional Control—of the "stick" relay arrangement; Track Circuits—detecting portion housed and integrated; Power Supply—arranged for standby battery; Adjustable Resistors—wired into the flashing light circuits to provide voltage adjustments; Plug-in Relays—rack mounted standard equipment.

The control housing is a 39½" x 24" style "RS" instrument case featuring hinged front and rear doors, provided with base cable outlet, aerial cable outlet with eye bolt, and ground terminal. Cast iron foundation piers are available as an optional feature to be ordered separately. A complete set of circuit schematics is furnished with each installation. *WABCO Signal & Communications Div. Circle 125 on Reader Service Coupon.*



Station Carrier

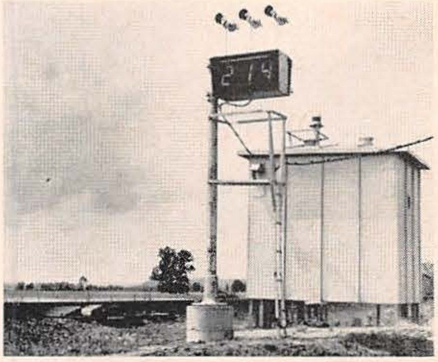
A new station carrier system increases five times the message carrying capacity of telephone cable. By stacking five voice channels at different frequencies on one cable pair, the system makes it possible to provide within industrial communication networks telephone service to more stations or to upgrade party lines without additional cable construction.

Designated the 861 cable carrier, the system can be installed by simply connecting the incoming and outgoing cable pairs to the station pole box along with a ground, connecting a repeater when required, and connecting the main lines. System maintenance is eased by use of plug-in circuit cards.

The station terminal is 12" high, 8" wide and 6" deep. The central control assembly occupies only 7" of vertical space on a 19" wide rack.

The 861 carrier requires no modification to existing dial switching equipment or telephones and operates with tone-dial or rotary dial telephones.

Five carrier channels in the 20 kHz to 120 kHz spectrum are provided and includes automatic level compensation. *Stromberg-Carlson Corp. Circle 126 on Reader Service Coupon.*



Display System

A human-engineered display system provides fast, direct information to train crews when a hot journal box has been detected. Designed to operate with a standard hot box detector, the model 8000 trackside display board visually alerts the train crew and presents a digital readout pinpointing the hotbox location by means of an axle count. The system consists of one trackside display board, axle locator unit, and test panel. A complete system is required for each detector site. *Servo Corp. of America. Circle 127 on Reader Service Coupon.*

- TELETYPE: The Inktronic page print operates at speeds of up to 120 characters per sec, equivalent to about 1,200 words per minute. The printer is available for use with either the 5-level teletype code or with the standard ASCII code. *Teletype Corp. Circle 128 on Reader Service Coupon.*

- CONTROL SYSTEMS: A new bulletin T2113 describes the Accu-code supervisory control systems. Descriptions of the systems, as well as engineering and supporting services supplied by the manufacturer, are included. *Stromberg-Carlson. Circle 129 on Reader Service Coupon.*

Locomotive Speed Control

A new hump locomotive speed control system will automatically control and regulate the speed of a locomotive through wide ranges of variable load conditions while pushing cars up to and over the crest of the hump in classification yards. This system operates with existing electrical and safety control circuit on the diesel engine and main generator without changing manual controls in the cab. Automatic control is achieved by programming signals on the throttle solenoid train lines for coarse power control, and by modulating current through the generator battery field for fine control of motive power. This locomotive-mounted system consists of a control panel, axle mounted speed sensor, locomotive power and logic control unit, and a battery field control unit. Analog or digital speedometer can be provided. The system can also be used, with minor modifications, for

(Please turn to page 62)

Upgrading communications doesn't have to cost $300 per mile. Ask your Stromberg-Carlson Man-on-the-Scene.

You can expand and upgrade your telephone communications without stringing another foot of wire or placing a single pole. A modern carrier system superimposed on your present facilities will do the job at minimal cost.

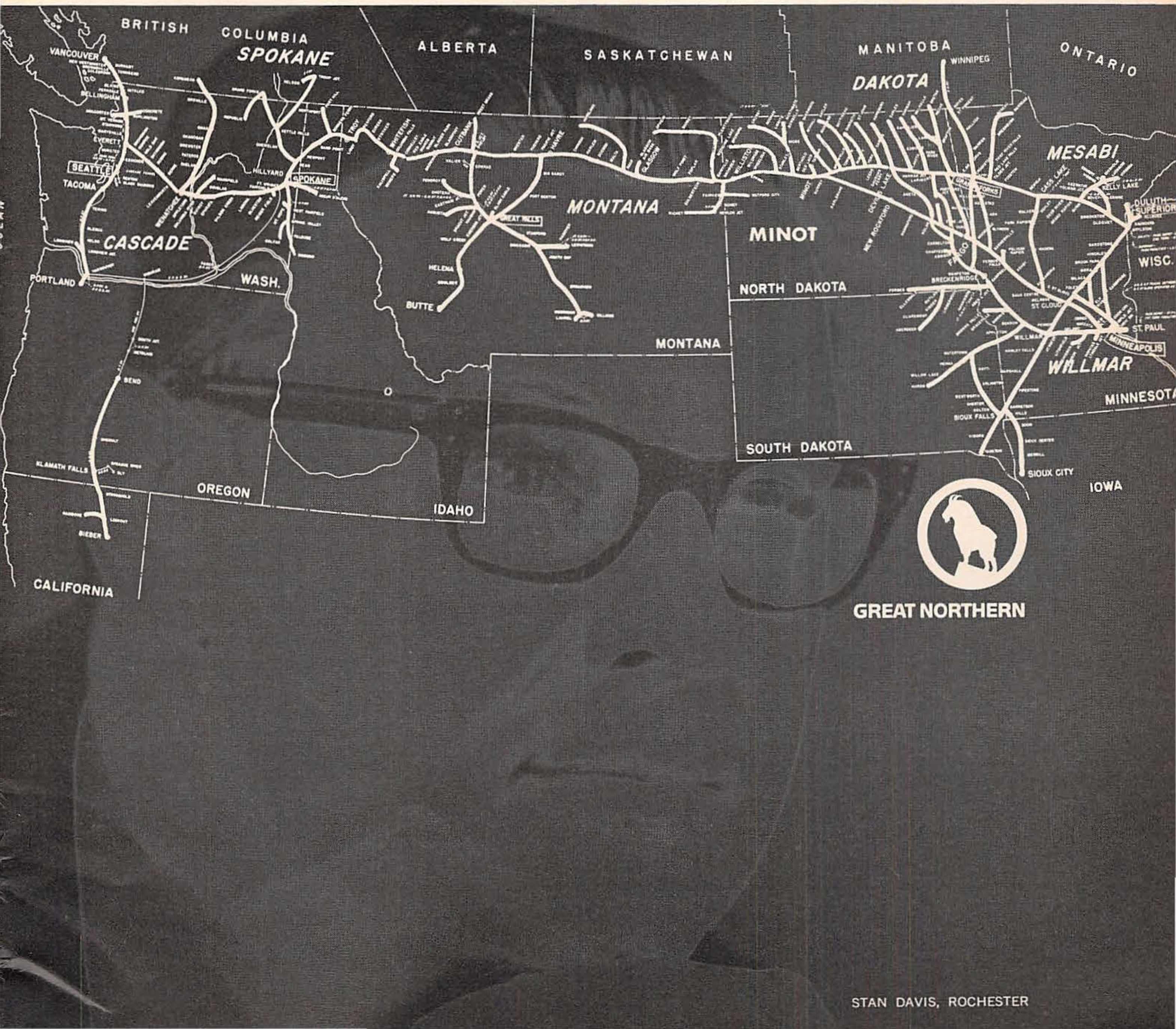
For example:

S-C 761 PARTY-LINE CARRIER. A transistorized medium-haul, open-wire carrier system that reduces load on message circuits up to 75%. Upgrades way stations operating with 35-40 parties per line to only 10 parties or less per line. For added efficiency and economy, the 761 is easily converted to the 765 Trunk Carrier system.

FREQUENCY-RINGING TRUNK ADAPTER. This unique Stromberg-Carlson product works hand in glove with party-line carrier to provide multifrequency ringing. It fills the bill when you're faced with the limitation of an existing PABX that offers only straight-line ringing.

The Stromberg-Carlson Man-on-the-Scene is as near as your telephone. He is backed by our complete customer services that include everything from systems planning to financing. Call him at 716-482-2200. Or write Railroad Division, Stromberg-Carlson, 100 Carlson Road, Rochester, N.Y. 14603.

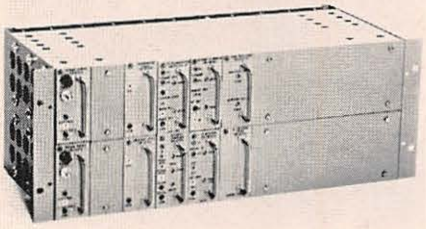
Stromberg-Carlson
A Subsidiary of General Dynamics


BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
SPOKANE
DAKOTA
WINNIPEG
MESABI
VANCOUVER
BELLINGHAM
EVERETT
SEATTLE
TACOMA
HILLYARD
SPOKANE
MONTANA
GREAT FALLS
MINOT
DULUTH
SUPERIOR
CASCADE
PORTLAND
WASH.
HELENA
BUTTE
NORTH DAKOTA
GRAND FORKS
FARGO
BRECKENRIDGE
ST. CLOUD
WISC.
ST. PAUL
MINNEAPOLIS
WILLMAR
MONTANA
MINNESOTA
BEND
KLAMATH FALLS
OREGON
IDAHO
SOUTH DAKOTA
SIOUX FALLS
SIOUX CITY
IOWA
BIEBER
CALIFORNIA
GREAT NORTHERN

STAN DAVIS, ROCHESTER

(Continued from page 60)

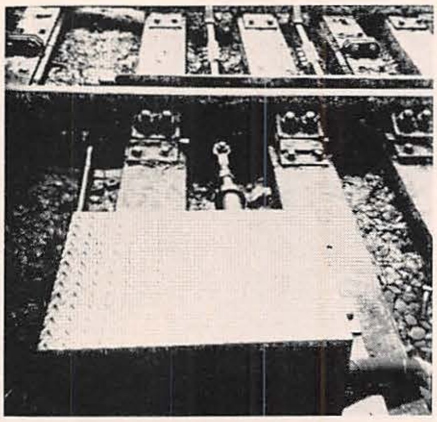
automatic, precise, speed control for loading and unloading systems. *WABCO Signal & Communications Div. Circle 130 on Reader Service Coupon.*



Data Modem

The model 3227 data modem is a coherent data set that can be used for data speeds of up to 1200 bits/second and higher over data lines. It is basically a three state, frequency shift data channel containing circuitry to combine clock and data inputs, transmit them, and deliver them separately but synchronized at the receiving end. The unit may be powered from AC or DC, with DC to DC converters available for isolation.

Channel frequency information: 2000 Hz center frequency, ±600 Hz frequency shift, 3000 Hz bandwidth for standard channel. Adjustable envelope delay equalizers are available in modular form. Amplitude equalizers are also available. Operating temperature is 10°C to +60°C. *RFL Industries, Inc. Circle 131 on Reader Service Coupon.*



Yard Switch Machine

A yard switch has been designed for use in flat switching yards. This fast-acting power-operated switch meets or exceeds standard AAR specifications. The YD-500 features light-weight, rugged design, an operating temperature range of −40° to +160°F, and an operating time of 4.5 sec. The switch operates from 115 volts, single-phase, 60 Hz power. It can be installed for either right-hand or left-hand application and is interchangeable in the field. *Servo Corp. of America. Circle 132 on Reader Service Coupon.*

- CHARGERS, INVERTERS, POWER SUPPLIES: A new catalog describes technical operations, design and maintenance features and outlines specifications for a complete line of float battery chargers, DC to AC inverters and DC power supplies. Equipment for microwave, telephone and communications application and a section on DC relays are also included.

A second catalog includes automatic battery chargers for industrial trucks and mine locomotives. *LaMarche Mfg. Co. Circle 133 on Reader Service Coupon.*

Reed Switch

Miniature printed circuit correed (MPC) is compatible with high density packaging demanded by the computer industry. Low silhouette (0.350" above the mounting surface) is said to simplify equipment and system design. Terminals are mounted on multiples of 0.050" centers to match circuit board grids. Magnetically shielded coils permit close spacing of modules. Each reed switch in an MPC correed consists of two overlapping ferro-magnetic blades sealed in a glass capsule, and separated at the overlap by a small air gap. They are plated with rhodium over gold at the contact area. *Automatic Electric Co. Circle 134 on Reader Service Coupon.*

- BATTERIES: The sealed rechargeable nickel-cadmuim battery is the subject of a paper delivered at a Battery User Seminar and discusses methods of charging as well as providing electrical and physical characteristics of nickel cadmium batteries, their sizes, packaging and uses. *Sonotone Corp. Circle 135 on Reader Service Coupon.*

- COAXIAL TRANSMISSION: A new bulletin describes the 46C coaxial transmission system which is capable of handling up to 600 multiplexed voice-frequency channels on two coaxial cables. The bulletin includes performance information, equipment description, block diagrams and photographs. *Lenkurt Electric Co., Inc. Circle 136 on Reader Service Coupon.*

Relay

The subminiature HGR2MT is a high-speed mercury-wetted contact relay designed for low-level switching applications. Available with "common open time" characteristics, the relay is designed for applications which make use of the "capacitor transfer" analog multiplexing technique. This module combines sensitive, high-speed operation with a small-sized, low profile enclosure for extremely compact printed circuit board mounting. These relays have been designed to operate at nominal voltage up to 200 Hz when driven from a source with a rise time of less than 1 μs. The cover material is cadmium-iridite finish steel. *C. P. Clare & Co. Circle 137 on Reader Service Coupon.*

Control Head

A new radio communication control head, model 19CA-1, is designed for use in either locomotive or caboose operation. The new unit is contained in a rugged die cast housing and is designed to provide two outstanding operator convenience features: an easily accessible hand set mounted on the front of the unit with a positive gripping hang-up feature, and an operator controlled pilot light dimmer. Other features include controls with mechanical stops at both ends and 10,000 hour pilot lamps. Other options are available including Chan-scan, channel reverting and tone call. *WABCO Signal & Communications Div. Circle 138 on Reader Service Coupon.*

Data Sets

The 1201B data sets are high speed modem for transmitting and/or receiving serialized digital data at 2400 bps over a voice bandwidth leased or private line. The T201B1 can be used in applications requiring internal timing. External timing applications require the T201B2. They are compatible with all features and options of Western Electric 201B data sets and will operate end to end with Western Electric equipment. Silicon solid state discrete components on plug-in printed circuit board modules provide easy access for component or board level maintenance. The data sets can be operated half duplex on a two-wire facility, or full duplex on a four-wire facility at a carrier frequency of 1800 Hz ± 0.01%. The data spectrum ranges from 600 to 3000 Hz. *Sangamo Electric Co. Circle 139 on Reader Service Coupon.*

- CARRIER: The B450 "ON" solid state converter permits the application of existing "O" type wire line carrier systems to cable. *Lynch Communications Systems. Circle 140 on Reader Service Coupon.*

Data Sets

A new high-speed, solid-state data set, designated T201B, is designed to accept data from a business machine, or data terminal, at the transmitting end and deliver data to a remote receiving terminal over private and public communication channels. The data set transmits at a fixed rate of 2400 bps and is available in a desk top cabinet model or for mounting in a 19-in rack panel. Four-phase modulation reduces channel bandwidth requirements to half that required by normal binary modulation.

Other features include end-to-end compatibility with the Bell System 201B data sets; crystal-controlled, internal-transmit clock; self-contained delay equalizer; selective or permanent automatic answer and EIA standard interface. *Sangamo Electric Co. Circle 141 on Reader Service Coupon.*

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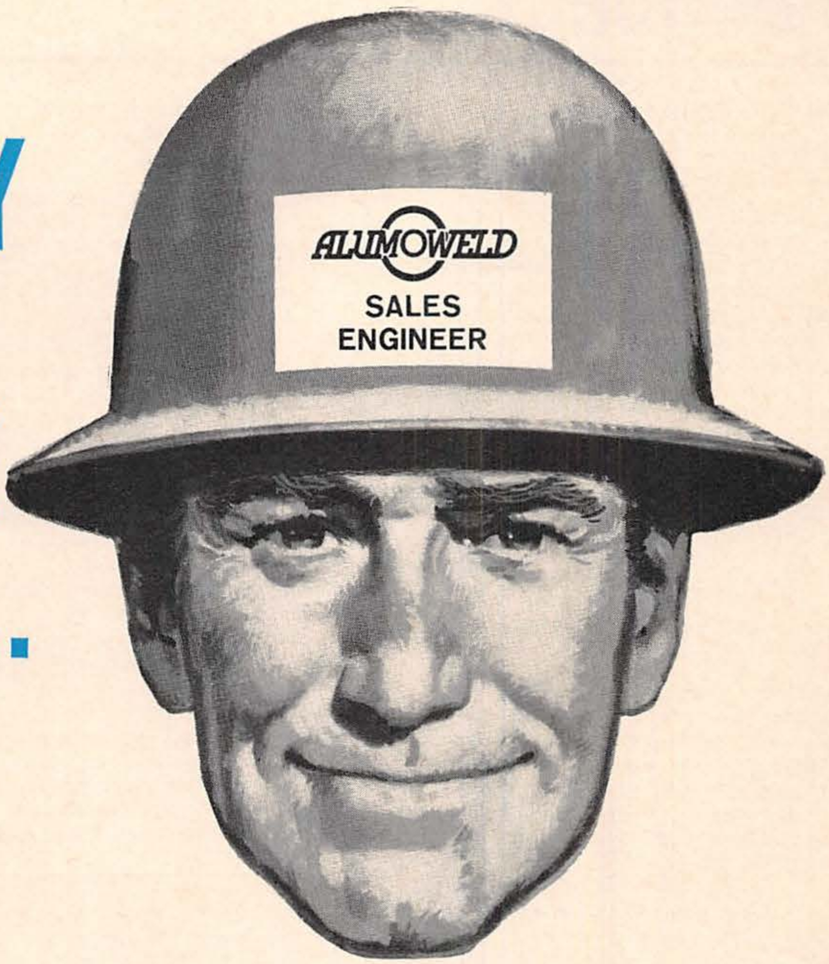

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You can't really know how much you can save with today's Alumoweld® Type M® guy strand until you talk to one of our sales engineers in terms of your specific guying requirements. There are three important reasons for these savings:

Low first cost, probably lower than you think. Also lower installation cost because Alumoweld Type M guy strand is lighter than any other high-strength strand, handles easier, goes up faster.

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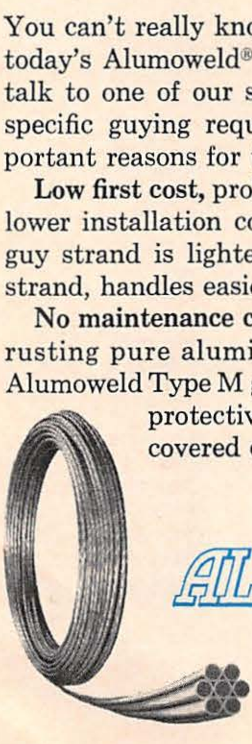

No replacement cost. Alumoweld Type M guy strand always retains its original strength, never needs to be replaced. Once up, it's up to stay.

Alumoweld Type M guy strand is available in a wide range of strengths. Our sales engineer who calls on you can show you exactly how much you can save by standardizing on Alumoweld Type M guy strand for all your guying requirements. Get in touch with him or write us for further details.

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Circle 25 on reader service card on page 78

Feedback

Varactor Tests

Q. How do you test varactors, silicon controlled rectifiers and tunnel diodes?

A. Varactors, silicon controlled rectifiers and tunnel diodes perform circuit functions which utilize particular characteristics in a specialized manner too complex to be readily and completely checked by common test equipment or circuitry, and direct replacement in the circuit gives the best answer. However a DC ohmmeter check of inter-terminal resistances in both polarity directions can locate short circuit or open circuit faults and may lead to the cause by comparing these resistances to a good one. When replacement is made and operation unsatisfactory or questionable, a re-check of these resistances may lead to the cause from the elements affected.

H. J. Clarke, General Manager, Canadian National Telecommunications

A. At this point, with the exception of varactors, the Great Northern communications department does not have enough of these items to form a basis for a sophisticated testing procedure. Varactors are appearing in two-way radio gear and these are tested largely by substitution and its effect on the circuit.

J. J. Kinney, Engineering Assistant, Communications Department, Great Northern

Point Detection

Q. How do you check point detection on power switch machines?

A. Disconnect power to switch machine by opening knife switch or disconnect wire and crank switch points open sufficient distance to insert gauge 6" back from point of switch. The point detector shall be adjusted both reverse and normal so that when the switch is locked with the $\frac{3}{16}''$ gauge inserted 6" back from the point, the rocker arm contacts will push the spring contacts away from the stops not more than $\frac{1}{16}''$. With $\frac{1}{4}''$ gauge inserted 6" back from the point, rocker arm contacts shall not touch spring contacts.

B. C. Eaton, Signal Engineer, Denver & Rio Grande Western

A. The first step one should take is to disconnect the power so the switch will not operate while checking point detection. Second, loosen the units on the lock rod connection and on the basket of the switch operating rod to allow the switch point to open $\frac{1}{4}''$ from normal position. Next check the point detector contacts to determine if they are open. Then check the normal indication relay to observe if it is de-energized.

If switch has a reverse point detector circuit in use, same method as mentioned above should be used with switch in reverse position. Point detectors should not be adjusted too close as vibration from trains may cause circuit to open. If you hand throw or crank switch open, indication circuits are opened; therefore, you cannot check point detection.

Signal Foreman

A. Power switch machines used by NYCTA are the WABCO electro-pneumatic model A-10, the WABCO electric Model M-4 and the GRS electric Model 5. All are equipped with lock rods and overthrow design at the throw bar so that the operating rod is held securely in the fully locked position. The first movement toward unlocking of any portion of the mechanisms will open the point detection or switch repeating controls. The first checks are opening of the circuits involved, with all equipment at rest. This will insure that the proper contacts are being considered. Train movements must be observed and protected at all times during test. Model board and other indications in towers or central control points must be observed and recorded by helpers or responsible towermen. Next, the unlocking of the machines must open the proper control contacts. In manually operating the machines, all power both air and electricity, is cut off before manual operation begins, so that visual check of contact opening is the test.

Last, with all equipment at rest, and with lock rods disconnected and shifted, the point detector rod can be gently disconnected to a point where the circuits open. This distance can be measured at a holding or adjusting nut and would correspond to a point opening that would be in gage, or not. The maximum allowable point opening is $\frac{1}{4}''$. Further details, with instructions to maintainer, with joint switch inspection details, are as follows:

"I'm a data transmission man, Mr. Hoskins. Tell me about the old-fashioned system, voice traffic!"

"I'm going to sneak a call home to my baby-sitter while he isn't looking."

Maintainers shall check and adjust switches with a standard $\frac{1}{4}''$ switch gage to insure that switches are locking properly and that point detector equipment is in proper adjustment at all times. All switch lock bars and rods are to be so adjusted as to prevent locking of switch mechanisms with standard $\frac{1}{4}''$ switch gage between the switch point and stock rail 6" back of the point, under power operation. All switch point detector or switch circuit controller equipment is to be so adjusted as to prevent closing of contacts controlled thereby, with standard $\frac{1}{4}''$ gage between the point and stock rail 6" from the point.

Maintainers must test switches in accordance with the above instructions and adjust, if necessary, each time the switch is serviced, with a maximum time of not less than one month between tests and adjustments.

Maintainers must give special attention to lock bar, lock rod and point detector adjustments during seasons when temperature changes occur in order to maintain proper adjustments.

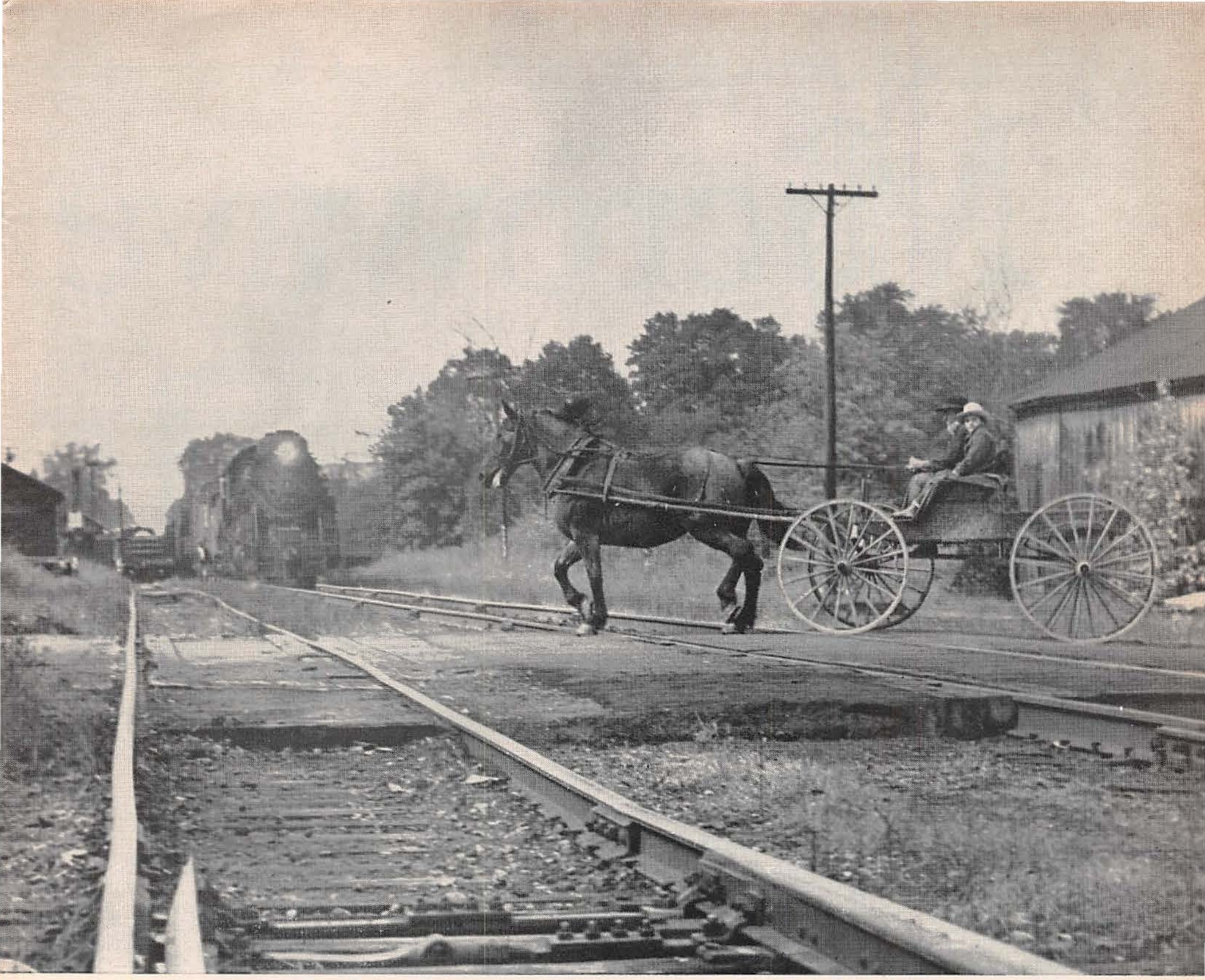
Maintainers must cooperate and perform all work required in the monthly joint switch inspection and test procedure with the track department as outlined on Form 58-65-6014 (RS&C May 1967, p. 23). They will check the switch point or movable point frog opening, the condition of all equipment, including switch rods, lock bars, lock rods, housings, rail braces, switch points, stock rails, ties, insulated joints and will make switch obstruction test, under power.

If switch locks, with standard $\frac{1}{4}''$ obstruction gage between switch point and stock rail 6" back of the point, corrective action must be taken immediately. Maintainers responsible for the equipment at the switch involved, by working schedule, will make the joint inspection and obstruction test. One copy of this report will be forwarded to the supervisor, signals.

Whenever the condition of switches or track special work does not permit proper operation or maintenance of signal apparatus, the fact must be reported to the office of the supervisor, signals.

Careful attention to the details will provide a check when the switch is serviced monthly and again on the joint switch inspection with the track foreman. (Copy of this last function included). All of these checks are static, with no train movement, with its loading and stressing of the trackway involved. All switches and special work must be observed as far as practicable, with trains proceeding over them so as to observe and report worn and loose track conditions which may be at the point of opening up switch and point detector circuits.

L. M. Belllinger, Superintendent Signals, Metropolitan Transportation Authority (New York City Transit Authority)



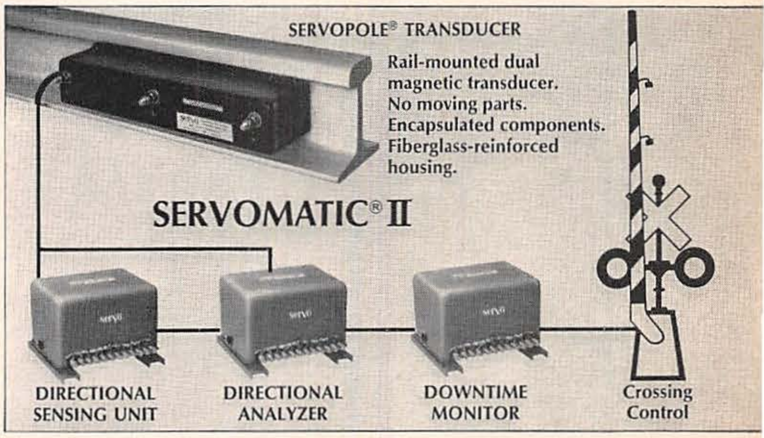
"I been thinkin', Ezra—it's gettin' so hectic 'round these parts—those railway critters oughtta set up one of them newfangled Servomatic crossing control systems!"

OUR horse and buggy friends were thinking a good number of years ahead of their time—but they were on the right track (no pun intended).

Today, things certainly do get "hectic" around railroad crossings, particularly at busy industrial switching areas. And that's exactly the place for our new SERVOMATIC® II Crossing Control System. SERVOMATIC II performs three basic functions: automatically determines train direction; provides required timing; actuates the crossing protection devices (flashers, gates, etc.)—*but only when necessary.* If the train stops short, or moves away from the crossing, protection is automatically timed out—permitting safe access to the crossing by vehicles and pedestrians. Switching operations are safe and more efficient, crossing downtime is minimized, and unnecessary traffic tie-ups are eliminated without the need for manual supervision.

SERVOMATIC II is built for long life with minimum maintenance. A unique "building block" arrangement allows easy, economical expansion of protection coverage for additional tracks in complex crossing areas.

If you're a railway "critter" who wants to know more about this "newfangled" system, just ask for Tech Data Publication 2012.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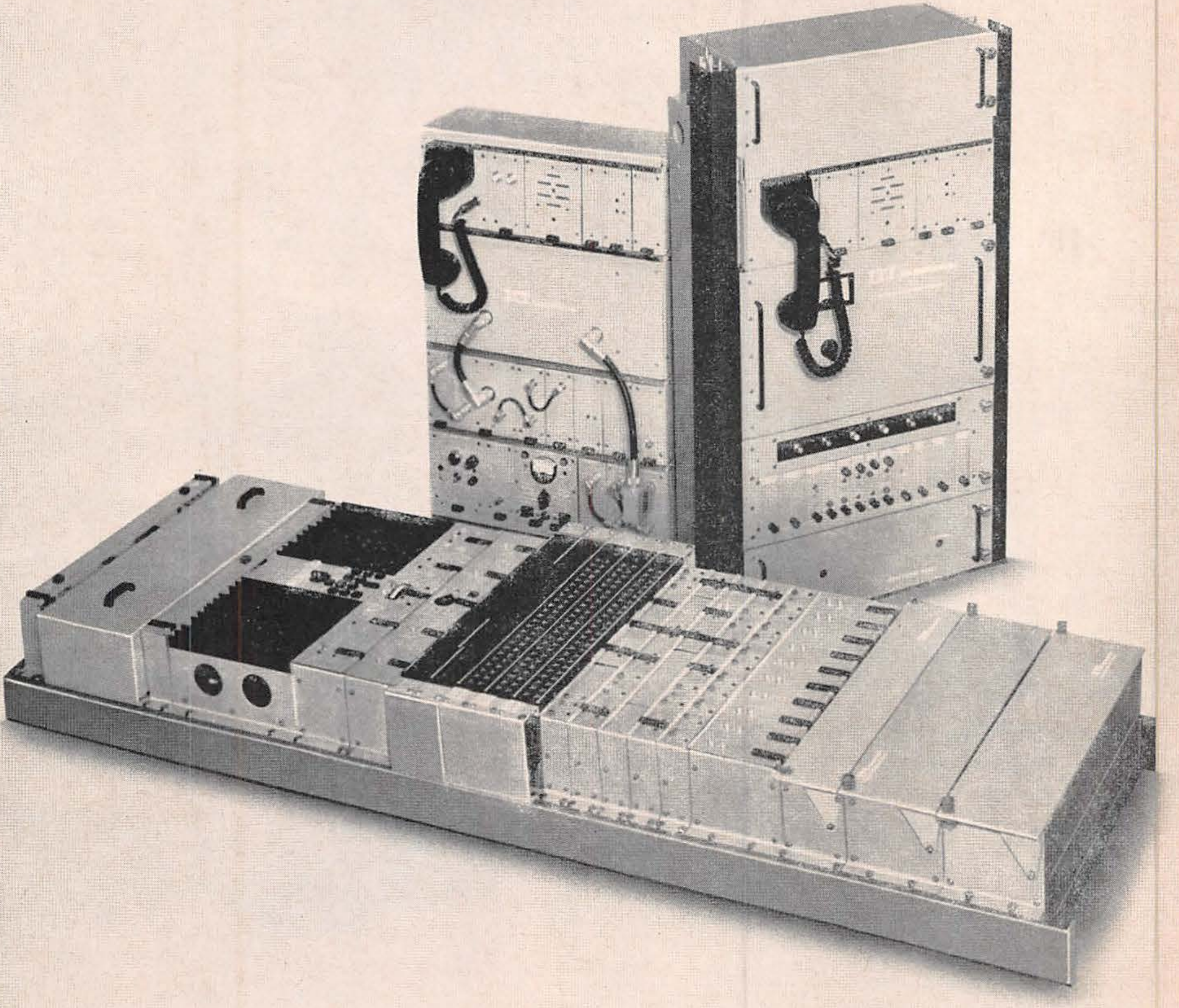
MEMBER RPI

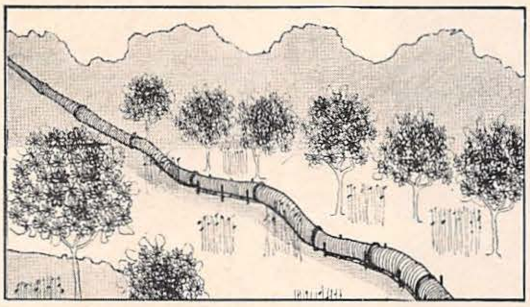
Circle 26 on reader service card on page 78

Microwave/

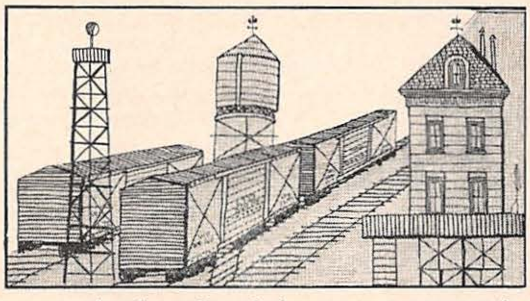


Multiplex

Versatile ITT Telecommunications systems tailor themselves to your transmission needs.

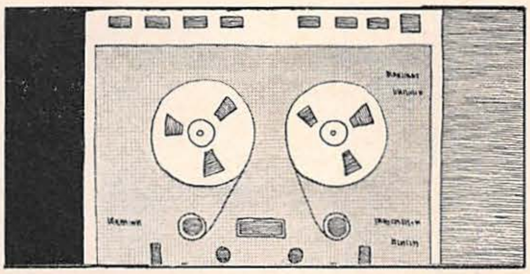


The number of applications for these systems is astonishing. They include pipeline control, transfer-trip, monitor and alarm, VHF control, traffic analysis, hot-box detection, data transmission, as well as voice communications.

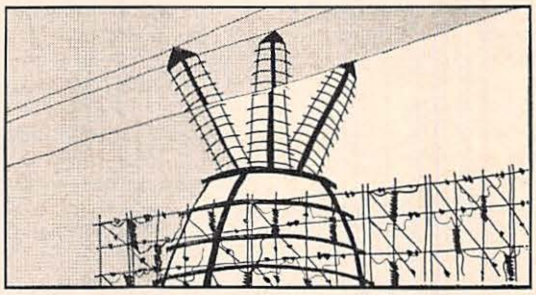


And each of these systems is designed to provide maximum flexibility. For example, the brand-new high performance A302 2000MHz Microwave system easily handles 300 channels and can be operated from 24 volt and 48 volt dc power sources as well as 115 volt ac.

The K65 Multiplex system uses "building block" concepts to let you expand easily from 3-channel and 24-channel units all the way to 960 channels.



If you're looking for "versatile" transmission systems with solid-state reliability and economy of operation, we have just what you need. We will be glad to send you complete information by return mail. Just write:



ITT Telecommunications, 2912 Wake Forest Rd., Raleigh, North Carolina 27602. Attn: Marketing Director.

ITT Telecommunications, a division of International Telephone and Telegraph Corporation, 320 Park Avenue, New York, N.Y. 10022.

Telecommunications Division ITT

Circle 27 on reader service card on page 78

NEWS BRIEFS

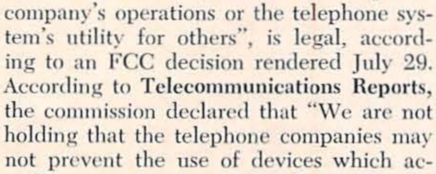
(Continued from page 13)

• FEDERAL RAILROAD ADMINISTRATION, DOT: Fourteen men from the Bureau of Railroad Safety have completed a five-day seminar in advanced railway signaling and control at the factory and offices of General Railway Signal Co.

Consisting of lectures, demonstrations and group discussions, the seminar included the subjects of electronics in railway signaling, high-speed solid state code system operation, high-frequency and overlay track circuits, rail-highway crossing protection, train control, high-frequency cab signaling, automatic train operation, and various items of signal equipment such as relays and switch machines. DOT men attending were **C. K. Robison**, Chief, Railway Signal & Train Control Branch, and the following signal and train control inspectors: **E. H. Anderson**, Portland, **H. J. Causley**, Washington; **J. J. Hacker**, St. Louis; **R. H. Harris**, Los Angeles; **W. W. Kreamer**, Minneapolis; **G. F. Laser**, Philadelphia; **A. D. Macdonald**, Albany; **R. A. McCurry**, Chicago; **O. M. Middleton**, Toledo; **J. W. Moffett**, Newark; **E. T. Powell**, Jacksonville; **E. V. Soper**, Headquarters; **S. H. Stotts**, New Orleans.

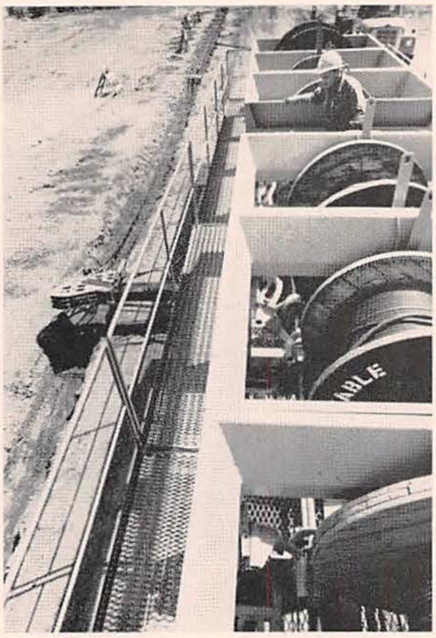
• INTERCONNECTION of the interstate message toll telephone system to any private system through any device which "does not adversely affect the telephone company's operations or the telephone system's utility for others", is legal, according to an FCC decision rendered July 29. According to **Telecommunications Reports**, the commission declared that "We are not holding that the telephone companies may not prevent the use of devices which actually cause harm, or that they may not set up reasonable standards to be met by interconnection devices. These remedies are appropriate; we believe they are also adequate to fully protect the system . . . The carriers may submit new tarriffs which will protect the telephone system against harmful devices, and may specify technical standards if they wish."

Known as the Carterfone case, because it involved use of equipment made by the Carter Electronics Corp., the FCC, on a split vote, granted a stay of cancellation of the tariff. At present, following opposition statements, filed by telephone companies, informed sources indicate that there are possibilities of equitable solution to this problem to be found. The sticky problem appears to be that of permitting use of any devices which electrically would not interfere with the quality of this telephone service and not set up discrimination.



"Is it true that today's signal plant is often a combination of old and new?"

• NEW YORK, NEW HAVEN & HARTFORD has ordered CTC equipment from General Railway Signal Co. to be installed on 7 miles of line in the vicinity of Attleboro, Mass. The installation will include Trakode, a rail-transmitted, either-direction coded track circuit control. Grade crossing protection in this installation will be controlled by audio-frequency overlay track circuits.



Westinghouse Electric is using a specially designed cable-laying machine for putting in the control cables in the San Francisco Bay Area Rapid Transit. The cable car goes at a speed of about 1 mph and the cable-laying machine can lay 6 cables at a time in a pre-dug trench 36" deep and two ft wide. The cable layer is 37 ft long without the tractor that pulls it, and 11 ft wide when the catwalks are down. It is operated by one man, standing at a small control center. It has its own motor with hydraulic controls to start the reels and brake them from over-reeling, and to operate the cable handling equipment. While rolling on conventional tires, the machine lays cable into a trench at grade level. By switching to its steel wheels which run on the track, the machine places cable in ducts on the aerial sections. It can feed cable from either direction or either side of the machine with a few minor adjustments.

In laying cable at grade level, a trenching machine goes first, then a machine that pours wet sand into the trench and after that the cable-laying machine, which carries six reels of cable up to 72" in diameter. If more than six cables are going into one trench, which is frequently the case, more sand is poured, then more cables are laid, up to 18 cables per trench. Both tracks are serviced from one trench, and every 1000 ft the cables feed wayside devices to provide the necessary controls. After the last sand layer, concrete is poured on the trench, then backfilling and grading complete the trenching operation.

• NORFOLK & WESTERN has placed in service 5 hotbox detector systems supplied by Railtron Corp.

• NORTHERN PACIFIC has received approval from the Federal Railroad Administration to replace 16 semaphore automatic signals with 12 searchlight automatic signals on 10 miles of line between Finch and Hysham, Mont.

• PENN CENTRAL will construct a new $26 million electronic freight classification yard near Columbus, Ohio. The new yard will have 40 classification tracks with room for expansion to 70 tracks to meet future needs. Also included will be a 10-track receiving yard, eight-track departure yard, diesel engine shop with fueling and sanding facilities, freight car repair shop, and car cleaning tracks. Estimates of the capacity of the new yard are 5,000 cars.

PC has purchased a portable radio control system for an overhead crane in the heavy duty repair shops at Altoona, Pa. The controls are worn by an operator who manages the crane from the floor of the shop rather than from the cab attached to the bridge of the crane. Equipment is being supplied by Motorola Communications and Electronics Inc.

PC, in connection with a modernization program at Conway, Pa. yard, has ordered VELAC speed control equipment, to control 14 retarders at its eastbound yard, from the WABCO Signal and Communications division.

PC has asked the FCC that tariff changes be suspended that pertain to the private line teletypewriter station equipment rate. In a statement to the FCC the railroad estimated its added cost from the new tariffs at more than 24%, or over $400,000 a year. It declared that the record so far in the FCC's general telephone rate investigation "suggests there is cause to doubt the soundness of AT&T's application of its ratemaking principles and factors, particularly in the area of private line services which include teletypewriter station equipment." According to **Telecommunications Reports**, the PC statement also said "The relevant market considerations, other ratemaking principles and factors, and the weight to be given costs of service are issues actively under consideration in the (telephone rate docket). A collateral determination here of the same issues would be repugnant to sound administrative process. Yet, inherent in a refusal to suspend the tariff revisions would be the Commission's acceptance and approval of Bell's position with respect to the controversial issues awaiting determination."

Also in the matter of the telephone rate case now going on, **Telecommunications Reports** recently stated that PC's Director of Communications Services, **Robert C. Karvwatt**, indicated that if the Bell System follows the ratemaking approach projected in the telephone rate case, it will lose substantial revenues in this area in addition to those stemming from proposed Telpak rate increases.

Also Karvwatt, foresaw a national network of railroad private microwave systems which "would surely work to the revenue detriment of AT&T" not only in the private line services "but also in the area of message toll and exchange services."

Karvwatt said he is "concerned with AT&T's seeming disregard for competitive alternatives to common carrier communications services." He recalled that the predecessor companies of Penn Central were well advanced on plans for private systems when the Bell System convinced them that Telpak would be a better method of meeting communications requirements.

"We must assume that were it not for subsequent regulatory proceedings, including the current one, AT&T's commitment to maintain rates competitive with private communications systems would not be in jeopardy," he declared. "It is clear from the evidence in this case, as well as other data available to me, that Penn Central can provide its own communications system at a cost lower than under AT&T's proposed tariffs."

He said Penn Central uses 227,000 miles of voice grade facilities and 162,000 miles of telegraph grade services, and reported that if the railroad "found it possible to obtain equivalent communications facilities through its own private system rather than through the Bell System, the Bell System would lose 46.7% of the revenues the railroad now pays for all services. The total figure," he said, "is $8,431,000."

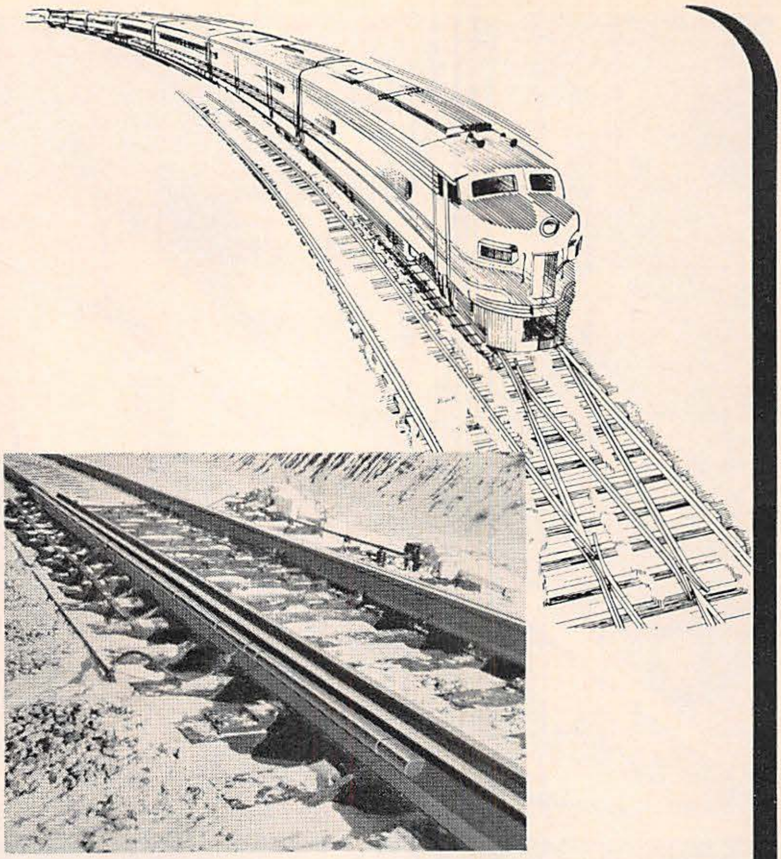
Should Telpak be discontinued, Karvwatt went on, the Bell companies would also lose revenues from collateral services, such as telephone switching equipment in the railroad's private network. In addition, he noted, Penn Central is the major participant in the railroad shared Telpak sections in which it participates, and smaller roads probably would be forced to discontinue their Telpak use.

"Other large railroads, such as the Southern Pacific in the Far West and Southwest, the Santa Fe in the West and Midwest, and the Southern have completed and are now operating their own communications systems," he pointed out. "The technology of these systems is much farther advanced than when Penn Central first undertook its program.

"There would be no major problems involved in putting Penn Central's private system into operation and linking it with the facilities that other major railroads now operate as part of their private communications networks . . . The effect of such a strong interconnected private network on AT&T should be carefully considered before any hasty, illconceived changes in its rates, charges, or services are made."

He declared that "If this Commission gives its stamp of approval to the pricing principles and factors upon which AT&T relies and to the manner in which AT&T has indicated it will apply those principles and factors, I am prepared to recommend to Penn Central's top management that it immediately proceed with plans to provide communications via an alternative method, such as a private system, and abandon as much of the Bell System's common carrier

(Please turn to page 70)



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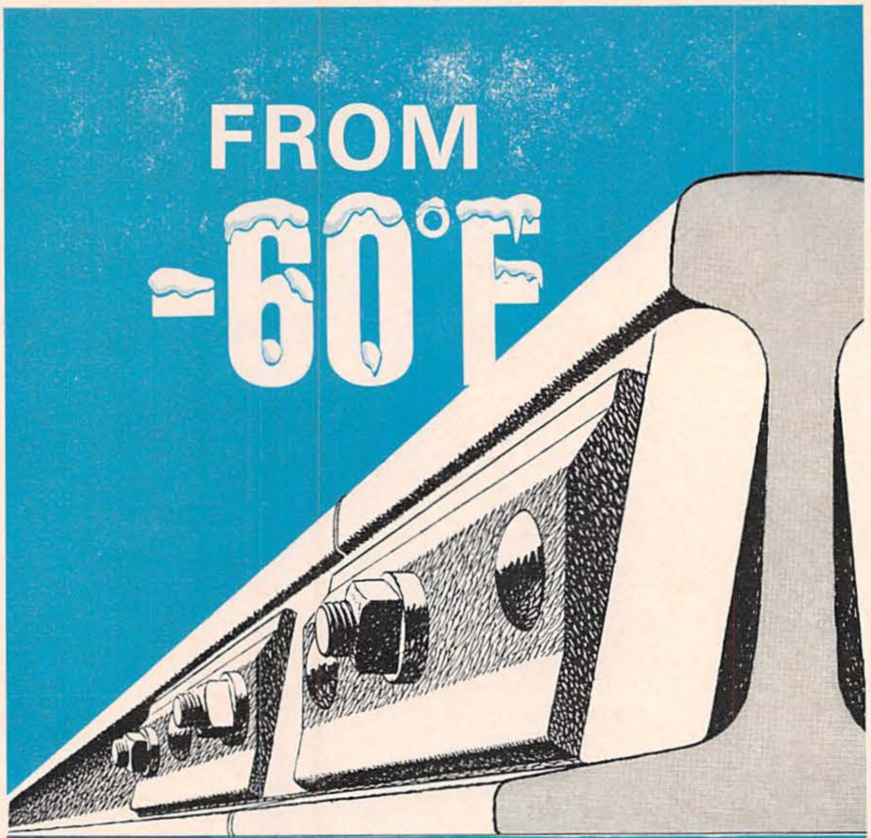

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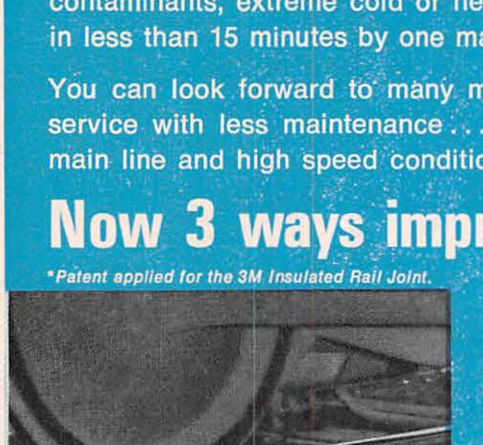

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3M COMPANY

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NEWS BRIEFS

(Continued from page 69)

services as possible."

- RAIL-HIGHWAY GRADE CROSSING ACCIDENTS decreased during 1967 as compared to 1966. The totals for 1967 were 3,932 accidents, down 165 from the previous year; 1632 persons killed, which was a decrease of 148 from 1966 and 3,812 injured, also a decrease of 231 from the previous year.

- RICHMOND, FREDERICKSBURG & POTOMAC has awarded a contract to Transcontrol Corp. to provide a route control machine and control equipment for controlling all switches and signals in traffic control territory between Richmond and Washington on the entire double-track main line.

- ST. LOUIS-SAN FRANCISCO has ordered hotbox detector equipment from General Railway Signal Co. for installation at 5 locations.

- SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT has awarded a $4.9 million contract to IBM Corp. for production of an advanced new automatic fare collection system.

Elements of the system will include self-service ticket vending machines, electronic currency change-making devices, and passenger gates that can automatically tabulate and subtract fares from a magnetically-coded ticket.

Passengers will be able to purchase either single trip or multiple fare tickets—recharging additional value to the tickets whenever the remaining amount is insufficient. A graduated rate structure will allow for varying fares—based upon exact distance traveled.

IBM was low bidder on the contract to produce the fare collection system for BART's 33 passenger stations.

Other bidders were the General Electric Co. with a minimum figure of $8.9 million, and Advanced Data Systems division of Litton Industries with a low figure of $20 million. BART engineers' estimate was a range of $6.8 to $9.8 million.

Under terms of the production contract, IBM will supply 96 ticket vending machines, 181 electronic passenger gates, 119 money-changing devices, 44 electronic agents' ticket-reading machines, and 47 "Addfare" machines by which, through insertion of additional coins, a passenger can increase the value of his ticket.

IBM also has agreed to provide maintenance for the fare collection equipment for a period of up to two years after the BART network is placed in operation.

A special feature of the electronic passenger gates will be their ability to remain open—with no impeding barrier to commuters—until a passenger fails to insert a magnetically valid ticket.

As the passenger exits from the station, the gate mechanism will also print visually on the ticket the amount of its remaining value.

Also, BART directors approved the award of a $1.6 million contract to the Philco-Ford Corp. for production of an electronic control and communications system to be installed at the District's future train and right-of-way maintenance yards in South Hayward and Oakland.

● SANTA FE has placed a $700,000 order for CW-60 solid-state microwave equipment with Radio Corp of America. This equipment will be installed at 28 stations from Riverdale, Kan. to Silsbee, Tex., approximately 685 miles.

Also, Santa Fe has awarded a $258,000 contract to Motorola Communications & Electronics, Inc. for a MC-300 single sideband multiplex microwave system. Having a 600-channel capability, this system will be part of the Riverdale, Kan. to Silsbee, Tex. microwave extension.

● SEABOARD COAST LINE will soon be operating 27 locomotives equipped with train control equipment supplied by General Railway Signal Co. Thirteen locomotives are being manufactured by General Electric and 14 are being manufactured by EMD division of General Motors.

SCL, in a hearing examiner's report of the Federal Railroad Administration, has received approval to discontinue a traffic control system between Dillon and Charleston, S.C., approximately 127 miles. Operation will then be by time table and train orders only. Also included in the FRA order is that the salvaged material freed by the discontinuance of the traffic control system between Dillon and Charleston, S.C. would be utilized to provide additional mileage of traffic control system on the merged railroad line between the territory of Hamlet, N.C. and Emery, Ga. or Atlanta, Ga. within a reasonable period of time. It does not contemplate the exact installation of 127 miles of new CTC.

● STANFORD RESEARCH INSTITUTE is the Federal Communications Commission's research and policy consultant in the computer/communications and land mobile radio frequency congestion problems.

As noted by *Telecommunications Reports:* Under the terms of the program as initially announced by the Commission a complete draft report of the data findings will be submitted for review in about six months, or at the close of the year. A fund of $500,000 was allocated from the FCC's fiscal 1968 budget.

FCC said "The computer study is to consider the regulatory and policy problems presented by the interdependence of computers and communications services and facilities," the subject of a present rulemaking inquiry in which well over 50 responses were submitted. The FCC added that the computer study is to be completed within six months, unlike the land mobile study, which is to be wound up in a year. The FCC added that "The land mobile project is to explore interservice sharing of land mobile radio channels and to study frequency assignment principles."

● SYLVANIA ELECTRIC PRODUCTS INC. has agreed to license the Westinghouse Air Brake Company to produce its KarTrak automatic car identification sys-

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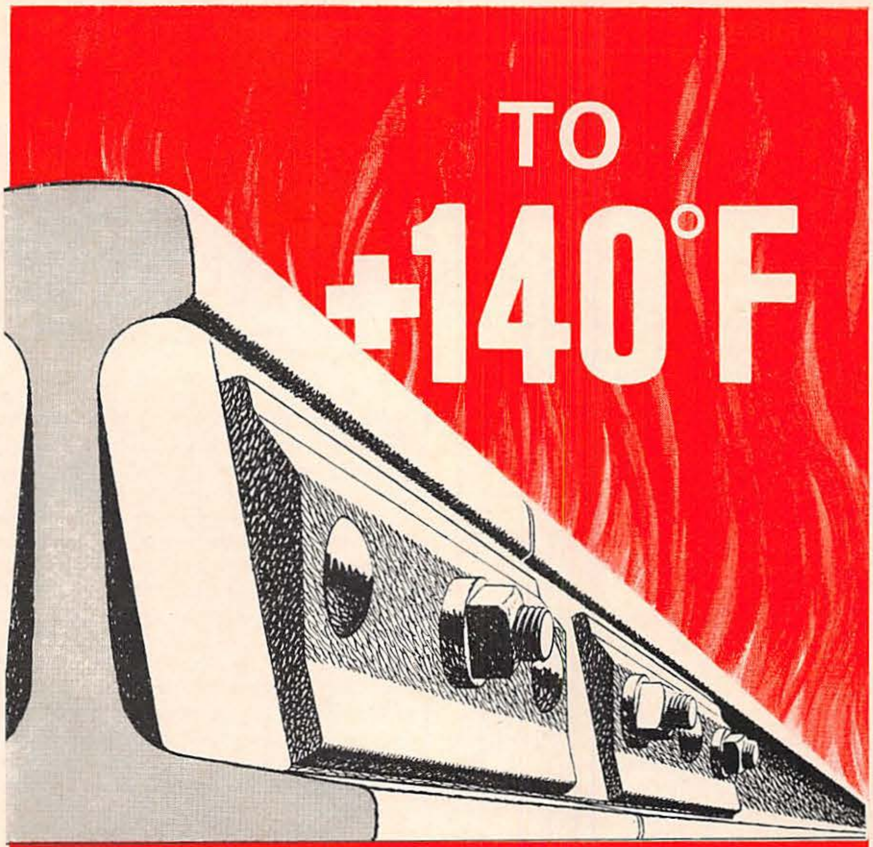

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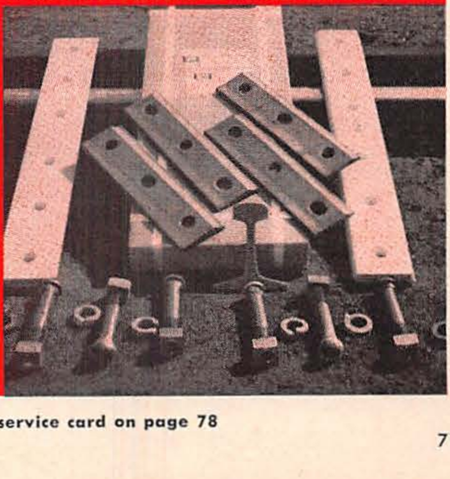


(Continued from page 71)

tem. The equipment will be manufactured by WABCO's Signal and Communications division, which will also have the right to market this AAR approved ACI system.

- TELPAK rate schedules slated to go into effect Sep. 1 may be the subject of court action. Just prior to the Sep. 1 deadline, the Aerospace Industries Association of America had asked the FCC to defer effectiveness of the tariff changes. Also, 10 major manufacturers have requested the commission to make the rate revisions spread out over 3 annual increments. About all that can really be said for Telpak, according to informed sources, is that the Commission stands on its decision letting the new tariffs go into effect.

- TRANSPORTATION-COMMUNICATION EMPLOYEES UNION have signed a contract including a "no-strike" clause effective until January 1970. The contract was signed with the National Railway Labor Conference representing the nation's railroads. The agreement covers 25,000 employes and provides for a general wage increase of 3.5% on July 1, 1968, 2% on Jan. 1, 1969, and 3% on July 1, 1969. Also included are liberalized vacation and holiday rules and the establishment of a classification and evaluation fund to adjust inequities in the pay structure of employes.

- UNION RAILROAD has ordered signal equipment including a power crossover and 12 electric locks from the Signal and Communications division of WABCO. The equipment will be installed at Port Perry, Pa.

Railroad Personnel

- CHESAPEAKE & OHIO/BALTIMORE & OHIO: **Jerry B. Dowdy,** circuit engineer-signals, appointed senior circuit engineer at Huntington, W. Va. **John L. Marsh,** assistant supervisor-signals, appointed circuit engineer. **Gary L. Ransbottom,** junior engineer-signals, appointed circuit engineer-signals. **Robert D. Iglehart,** CTC engineer, appointed engineer of signal materials and standards. **Julian R. Tennent, Jr.,** circuit designer, appointed engineer-signal standards. **James W. Mabe,** junior circuit engineer-signals, appointed assistant engineer-signal materials and standards. **William D. Kelley,** signal communication application engineer, appointed junior circuit engineer-signals. **David M. McClure,** signal and communications draftsman, appointed signal application engineer. **Gilmer O. Johnson,** assistant signal maintainer, appointed signal application engineer. **Fred King,** signal maintainer, appointed signal application officer. **Carl E. Root,** signal helper, appointed signal application engineer. **James B. Winter,** signal foreman, appointed junior circuit engineer. **Joseph B. Crisp, Jr.,** signal application engineer, promoted to junior circuit engineer-signals.

Harvey Alexander
Penn Central

Virgil L. Cosey
Southern

Forrest H. McIntyre
Southern

Lloyd A. Forlaw
Southern

- LOUISVILLE & NASHVILLE: **H. N. Dixon,** supervisor, communications and signals, Tullahoma, Tenn., has retired. **C. C. Rankin,** foreman-signal repair shop, Louisville, Ky. appointed assistant signal supervisor with headquarters at Chattanooga, Tenn. **J. V. Walker,** supervisor communications and signals, Corbin, Ky., has retired. He was succeeded by **C. D. Winstead,** formerly assistant signal supervisor, Evansville, Ind. **D. B. Collier,** draftsman, Louisville, Ky. appointed assistant signal supervisor, Evansville, Ind. **K. K. Tant,** assistant signal supervisor, Nashville, Tenn. has retired on disability. **J. D. Wyatt,** signal repair shop, Louisville, has been appointed acting assistant signal supervisor at Nashville.

- MILWAUKEE ROAD: **William D. McGuire,** system supervisor-telephones, has retired.

- MISSOURI PACIFIC: Six men from the office of the signal and communications engineer have received diplomas after completing a two-year course from the Cleveland Institute of Electronics. They are **Virgil H. Bradley, Thomas M. Bryant, Jr., John F. Ritter, Jr., Rolland H. Brownfield, Phillip E. Montague and James R. Myles.**

- PENN CENTRAL: In restructuring the engineering department, the following appointments have been announced. **Frank G. Fotta,** engineer-communications and signals at Chicago, has been appointed regional engineer-C&S. At Philadelphia, **John G. Cunningham,** engineer-C&S, has been appointed regional engineer-C&S. At Pittsburgh, **Lawrence E. Light,** engineer-C&S, has been appointed regional engineer-C&S.

Harvey Alexander, recently appointed manager communications and signals at Philadelphia, was born in Conesus, N.Y. on Sept. 11, 1919. Following graduation from the Rochester Institute of Technology in 1940, he joined NYC as a draftsman. In 1949 he was appointed assistant engineer, and a year later promoted to assistant supervisor of signal construction. In 1951, Mr. Alexander served briefly as general signal inspector, and then was appointed assistant engineer signals. Four years later he was appointed office engineer signals, and in 1958 promoted to system chief signal inspector at Cleveland. In 1962, he was appointed district signal engineer at Indianapolis and three years later appointed district engineer-communications and signals. Subsequently, he was district engineer at Indianapolis and in the most recent reorganization, following merger of New York Central with the Pennsylvania, he was appointed manager of communications and signals at Philadelphia.

Robert Harp, Jr.
Southern

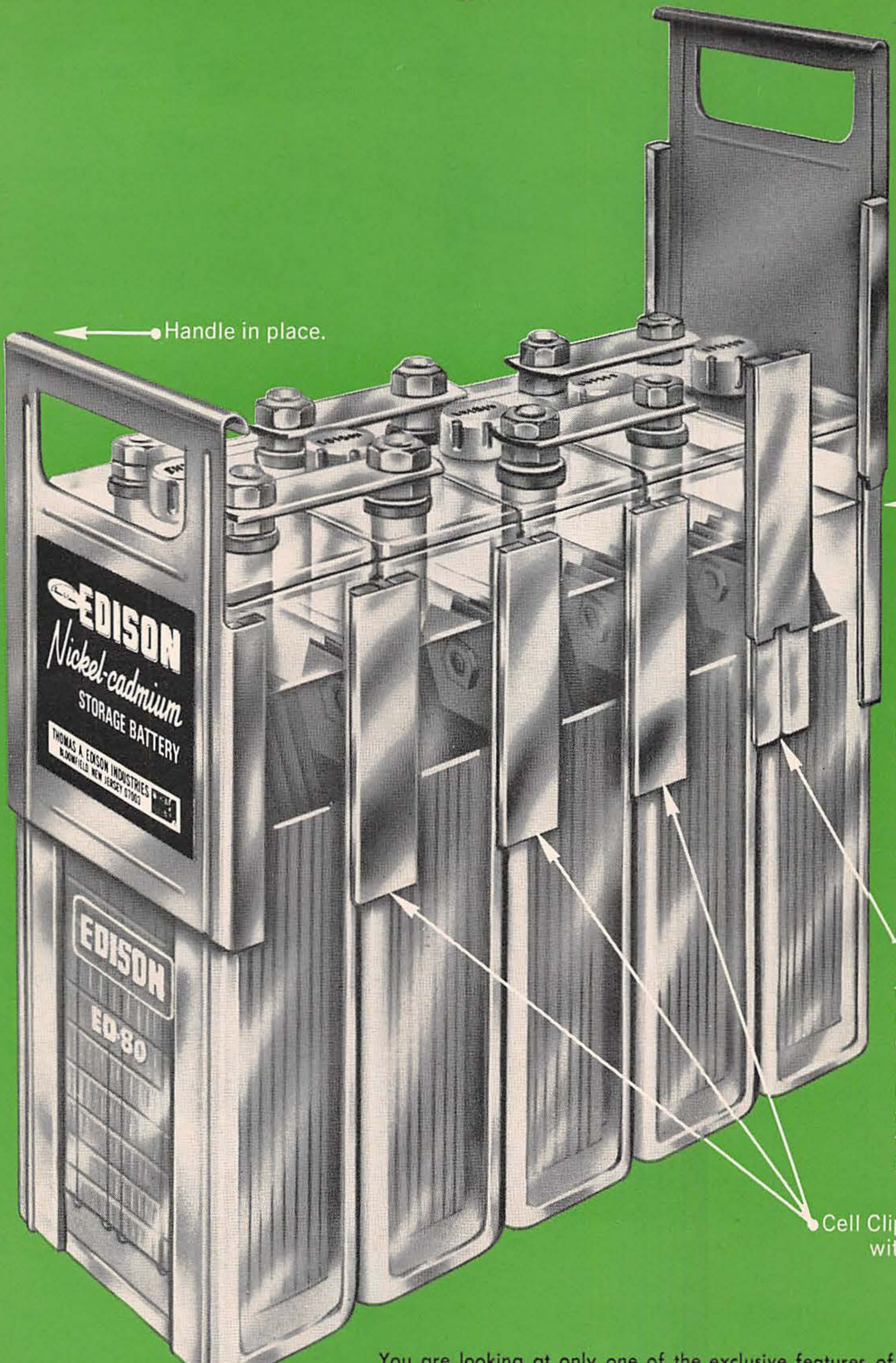
Norman F. Yount
Copperweld

- READING: **John J. Foster,** general mechanical superintendent, appointed chief, signal, electrical and communications engineer, succeeding **George B. Blatt** who is appointed assistant chief engineer-staff consultant, SE&C.

- SOUTHERN: **Virgil L. Cosey,** district signal and electrical engineer at Macon, Ga. was born Dec. 30, 1906 in Taylor County, Ga. He joined the Central of Georgia Railroad in 1926 as a signal helper and subsequently was promoted to signalman, relay repairman and telephone maintainer. In 1943 he was appointed signal draftsman and two years later promoted to signal foreman. He held the position of assistant supervisor of signals from 1945 to 1951, at which time he was appointed supervisor of signals. In 1960 Mr. Cosey was appointed supervisor communications and signals and two years later appointed assistant superintendent communications and signals. In 1964, he was promoted to assistant signal superintendent and in February 1968, Mr. Cosey was appointed district signal and electrical engineer, his present position.

Forrest H. McIntyre, district signal and electrical engineer at Knoxville, Tenn., was born in Robbins, Tenn. on May 22, 1932. A graduate of Chicago Technical College, he joined Southern as a signal helper in 1950. Two years later, he was promoted to signalman and by 1954 had been promoted to the position of signal foreman. Three years later, he was promoted to assistant signal and electrical supervisor and, in 1962, Mr. McIntyre held the position of signal and electrical supervisor at Danville, Ky. In February of this year he was pro-

(Please turn to page 75)



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240 a.h.

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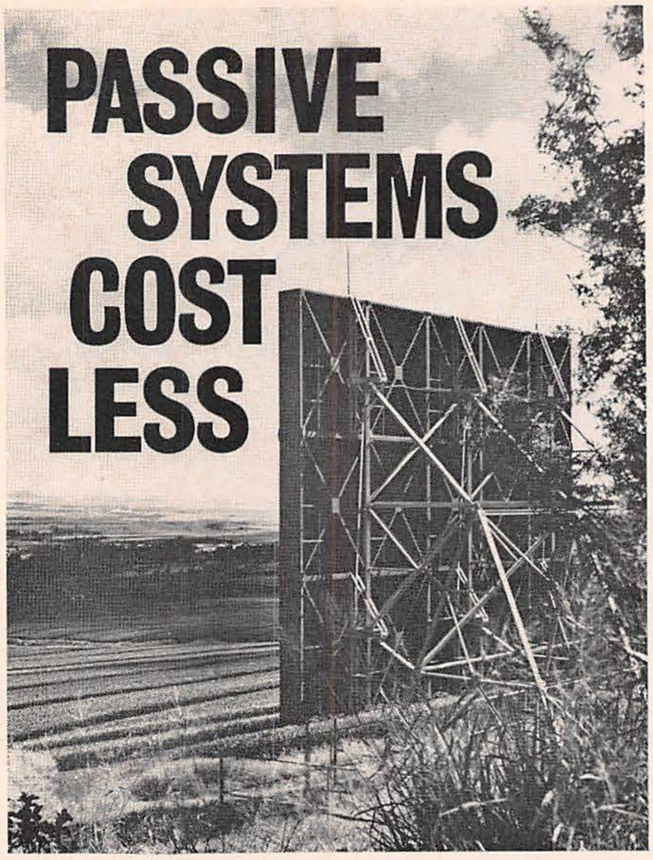

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Circle 32 on reader service card on page 78

(Continued from page 72)

moted to his present position of district signal and electrical engineer.

Lloyd A. Forlaw, assistant district signal and electrical engineer at Greensboro, N.C. was born on April 28, 1924, in Greensboro, N.C. He joined Southern Railway in 1948 as a signal helper and, a year later, was promoted to signalman. In 1950, Mr. Forlaw was appointed signal draftsman and, five years later, promoted to the position of signal and electrical inspector. From 1956 to May 1962, Mr. Forlaw was assistant signal and electrical supervisor, at which time he was promoted to signal and electrical supervisor. Four years later, he was promoted to general S&E supervisor at Charlotte, N.C. In February of this year, he was promoted to his present position.

Robert Harp, Jr., electrical engineer at Atlanta, was born Feb. 6, 1922, in Fayette County, Ky. He holds a bachelor of science degree in electrical engineering from the University of Kentucky, graduating in 1949, at which time he joined the railroad as a signal helper. A year later, he was promoted to signal draftsman and, by 1951 was signal and electrical foreman. In 1954, Mr. Harp was appointed signal construction supervisor; the next year he was appointed assistant signal and electrical supervisor. In 1957, he was promoted to circuit design engineer and, a year later, appointed signal and electrical supervisor. In February 1968, he was appointed to his present position of electrical engineer.

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Supply Trade News

● COPPERWELD STEEL COMPANY: **Norman F. Yount** has been appointed vice president and general manager—Wire and Cable Division. Mr. Yount is a graduate of the University of Pittsburgh with a degree in business administration. He joined Copperweld in 1940 and has served as division controller and assistant to the executive vice president of the Steel Bar Division. More recently, he has been vice president, administrative on the executive staff.

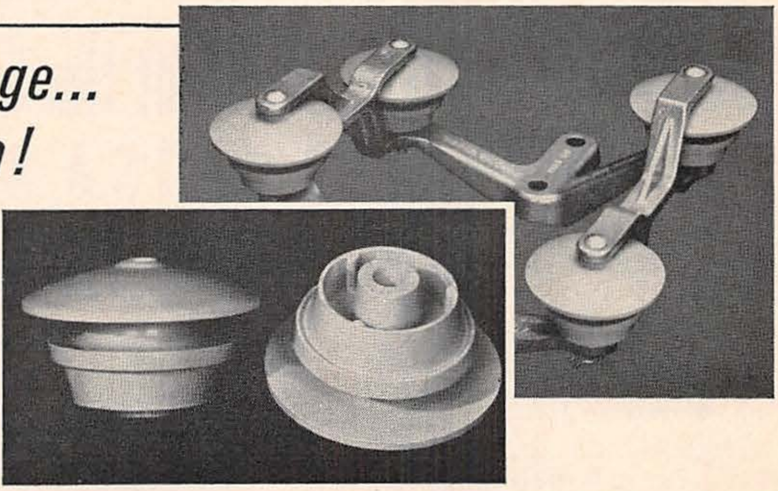
Frank J. Cullen
Cullen-Western

George L. Hudson
Cullen-Western

● FANSTEEL INC. is selling its rectifier products portion of its business to Power Conversion Products, Inc. This new company will be headed by **Edward S. Weil, Jr.**, former manager of rectifier products division of Fansteel.

● FEDERAL SIGN & SIGNAL CORP. has acquired Western Industries, Inc. including its subsidiary, Western Railroad Supply Co. Also acquired is the Cullen-Friestedt Co. **George L. Hudson**, formerly chairman and president of Western, will manage the new division as a vice president of Federal. **Frank J. Cullen**, former president of Cullen, has been ap-

(Please turn to page 76)



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NEWS BRIEFS

(Continued from page 75)

pointed divisional vice president in charge of marketing. **Alexander A. Wright,** formerly executive vice president of Western, has been appointed divisional vice president.

● GENERAL RAILWAY SIGNAL CO.: **Sanford H. Steward, Jr.,** former district sales manager for Servo Corp. of America in Chicago, has been appointed sales engineer to work out of the Chicago office of GRS. Mr. Steward is a graduate of Ohio State University.

John K. Records, president, has been appointed group executive of General Signal Corp., the parent company. He will have responsibility for GRS, Avion Electronics and Cardion Electronics. Succeeding Mr. Records, as president of GRS, is **Gerald E. Collins,** formerly general manager of the Instrument Transformer Business division of General Electric Co.

● GRAYBAR ELECTRIC CO. INC.: **W. H. Mayben, Jr.,** district sales manager, Tampa, Fla., appointed district manager succeeding **D. L. Harper,** retired **A. P. Torres** succeeds Mr. Mayben. **G. E. Robie** appointed district sales manager at Kansas City. The following were appointed managers of company branches: **J. H. Flagg** at Miami, Fla.; **D. W. Mitchell** at Denver, Colo.; **K. R. Klise** at Butte, Mont.; **J. W. Bolt** at Huntsville, Ala.; and **J. F. Kluttz** at El Paso, Texas.

● KERITE CO. **F. Thiell Sampson,** assistant western manager, has been appointed western sales manager, railroad division with headquarters in Chicago. Mr. Sampson is a native of Bloomingon, Ill. and a graduate of the University of Illinois.

John B. Fleer, sales representative in the Chicago office, has been appointed assistant sales manager, railroad division with headquarters in Chicago. Mr. Fleer joined Kerite Co. in 1951 as office manager, in Chicago.

● LYNCH COMMUNICATION SYSTEMS INC.: **Delbert G. Larson,** sales manager, has been promoted to vice president, sales. Mr. Larson is a graduate electrical engineer from Washington State University, and he has been with Lynch since 1962.

Donald Green, chief engineer, has been promoted to vice president, engineering. Mr. Green is a graduate of the British Institute of Electrical Engineers and has for the last eight years been in Lynch's development engineering department.

● MARQUARDT INDUSTRIAL PRODUCTS CO.: **Mark R. Miller,** management consultant, has been appointed president, succeeding **H. F. Goelzer,** resigned. **Gene K. Adams,** midwest manager, Chicago, has been appointed manager, sales. **Philip E. Pierce,** has been appointed midwest regional manager.

Mr. Adams was born in Lincoln, Neb., June 7, 1928. He began his career in the

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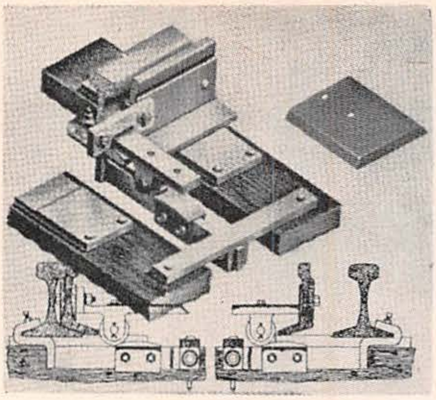

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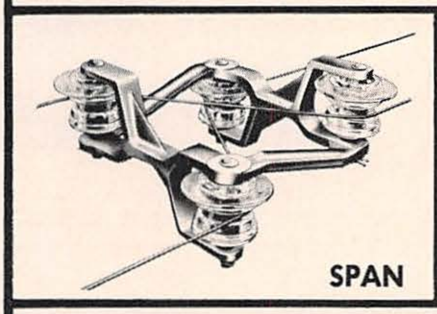

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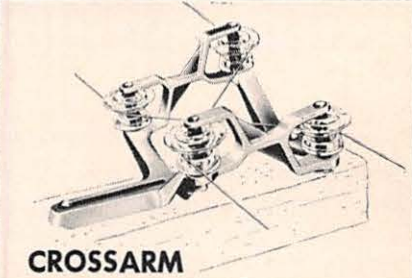

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Advertisers' Index

Buckeye Telephone & Supply Company 75

Carbone Corporation, The 14
Cardion Communications 57
C & D Batteries, Div. 3
Copperweld Steel Company 63

Diversified Metals 44-45
Drill Carrier Corporation 76
Du Mont Mobile 35

Edison Industries, Primary Battery Division,
Thomas A. 73
ESB, Inc. 10

Fansteel Metallurgical Corp. 15

General Railway Signal Co. 11, 77
Gould National Batteries Inc. 6
Graybar Electric Company 16-17

Hayes Track Appliance Co. 77

ITT-Telecommunications 66-67

Joslyn Electronic Systems Div. of
Joslyn Mfg. and Supply Co. 8

Kerite Company, The .... FC
Kleinschmidt Div. of SCM Corp. 55

Lenkurt Electric Company 4

Marquardt Corporation, The 7
Microflect Company, Inc. 74
3M Company 70-71

Northeast Electronics Corporation 46

Raco (Railroad Accessories Corp.) ....IFC
Radio Corp. Of America, Microwave Dept. 20
Rails Company, The 69
Rohn Manufacturing Company 19
Kleinschmidt Div. of SCM Corporation 55

Secode Electronics ....IBC
Servo Corporation of America 59, 65
Simplex Wire & Cable Co. 18
Stromberg-Carlson 61

Transandean Associates, Inc. 76

United States Steel 9

Vapor Corporation 12-13

WABCO–Signal & Communications Division ..39-42
Western Railroad Supply Co.
Division of Western Industries ....BC
Wheel Checkers, Inc. 74

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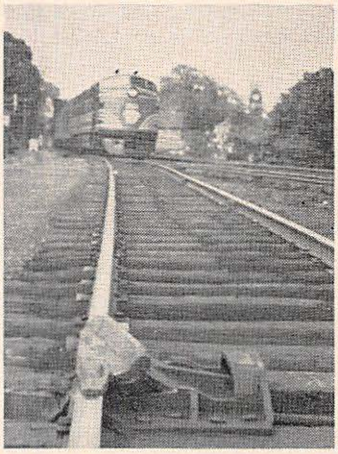

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(*Continued from page 76*)

signal department of the Burlington in 1944 while attending classes at Illinois Institute of Technology. Subsequently, he became engineer of signal design. In 1957, Mr. Adams became a sales engineer for Griswold Signal Co. Two years later he joined Union Switch & Signal in Chicago as a sales engineer. In 1963, he was appointed assistant district manager. A year later, he was appointed district manager at New York. In 1966, he was appointed midwest manager for Marquardt in Chicago.

A native of Abingdon, Ill., Mr. Pierce attended Monmouth College. In February 1953. he became a construction helper in the CB&Q signal department. Subsequently, he was a draftsman in the office of the signal engineer. In 1963, he was appointed a sales engineer in the Chicago office of Union Switch & Signal, now the S&C division of WABCO. He recently resigned that position to join MIPCO as midwest regional manager.

● RAILTRON CORP. employees, **W. M. Pelino, L. E. Keeton** and **R. A. Moenich** have been vindicated of charges brought before New York State Supreme Court by Servo Corp. of America. They had been charged with the theft of trade secrets and confidential information, violation of fiduciary duties, conspiracy, and breach of contract in a suit filed in 1965.

In dismissing the complaint, Justice Mario Pittoni stated, ". . . I can only conclude that plaintiff was hiding the fact that it had no secret or unique method of manufacturing a hot box detector." All causes of action against the defendents were dismissed.

● ROME CABLE: **Glenn A. Brodock** has been appointed general sales manager.

S. H. Steward, Jr.
Gen Ry Signal

F. Thiell Sampson
Kerite

John B. Fleer
Kerite

Gene K. Adams
Marquardt

Philip E. Pierce
Marquardt

H. E. Blakesley
Rohn Mfg

William J. Lyneis
Simmons-Boardman

Ron M. Giallonardo
Simmons-Boardman

● ROHN COMMUNICATION FACILITIES CO.: **H. E. Blakesley,** former Rohn Manufacturing Co., western division manager, has been appointed sales manager at Richardson Tex.

● SIMMONS-BOARDMAN PUB. CORP.: **William J. Lyneis** has joined the Railway, Marine and Plant Location sales staff as district manager, western region, with headquarters in Chicago. He has been associated with Hunter Publishing Co. and Conover Mast Publications.

Ron M. Giallonardo, district manager of the sales staff at Pittsburgh, Pa., has been appointed regional sales manager there.

● SIMPLEX WIRE & CABLE CO.: **William A. Whittemore** has been appointed corporate director of marketing. A native of Boston and a graduate of Yale University, Mr. Whittemore joined Simplex in 1956. Following several assignments in sales and marketing, he was appointed marketing manager of the Cambridge Division in 1963. Two years ago, he was named general manager of the Hitemp Division.

● SYLVANIA ELECTRIC PRODUCTS INC.: **John W. Barriger,** former superintendent of transportation AT&SF, has been appointed manager of transportation control systems. He succeeds **David J. Collins** who will continue as general manager of Sylvania Rail Data Corp. Mr. Barriger, a graduate of Massachusetts Institute of Technology in 1949, joined the Santa Fe in 1950 and served in various capacities as trainmaster and, in 1965, was appointed superintendent of transportation.

● TRANSCONTROL CORP.: **Robert L. Oswald** has been appointed vice president, sales, central and western region.

● VAPOR CORP.: **Crant W. Pearson** has been appointed sales engineer for the industrial control systems section of the Rail and Transit Division. **J. Samuel Keller** has been appointed administrative assistant to the vice president of the same division.

John W. Barriger
Sylvania

Wm. A. Whittemore
Simplex Wire

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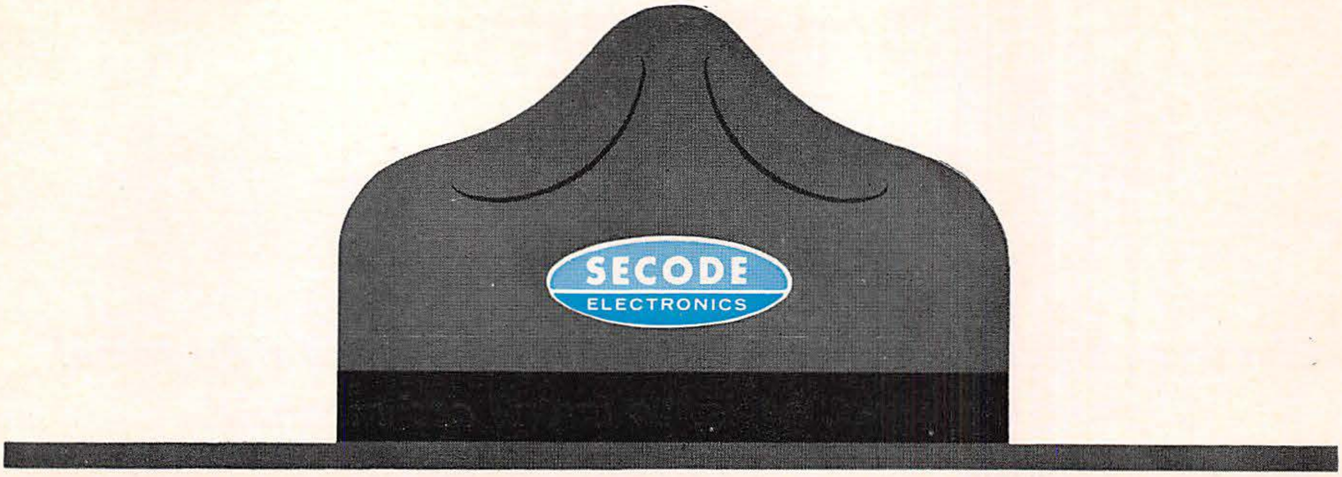
29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
101 102 103 104 105 106 107 108 109 110 111 112 113 114 115
116 117 118 119 120 121 122 123 124 125 126 127 128 129 130
131 132 133 134 135 136 137 138 139 140 141 142 143 144 145

NAME ....
TITLE .... RAILROAD ....
ADDRESS ....
CITY .... STATE .... ZIP # ....

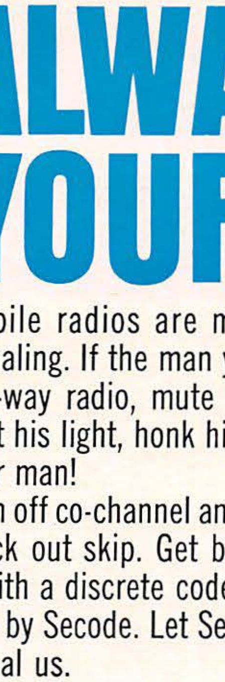
THIS COUPON MUST BE USED ON OR BEFORE NOVEMBER 30, 1968



ALWAYS GET YOUR MAN!

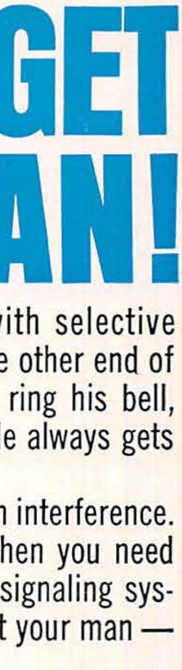
Mobile radios are more effective with selective signaling. If the man you seek is on the other end of a 2-way radio, mute his speaker and ring his bell, light his light, honk his horn . . . Secode always gets your man!

Turn off co-channel and intermodulation interference. Block out skip. Get better attention when you need it with a discrete code address digital signaling system by Secode. Let Secode help you get your man — signal us.



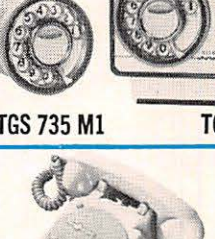
VP-1

TGS 735 M1



TGS 740

SD-30



MARK 60

SD 2 DS

RPD 673

CIH 7A

SECODE ELECTRONICS

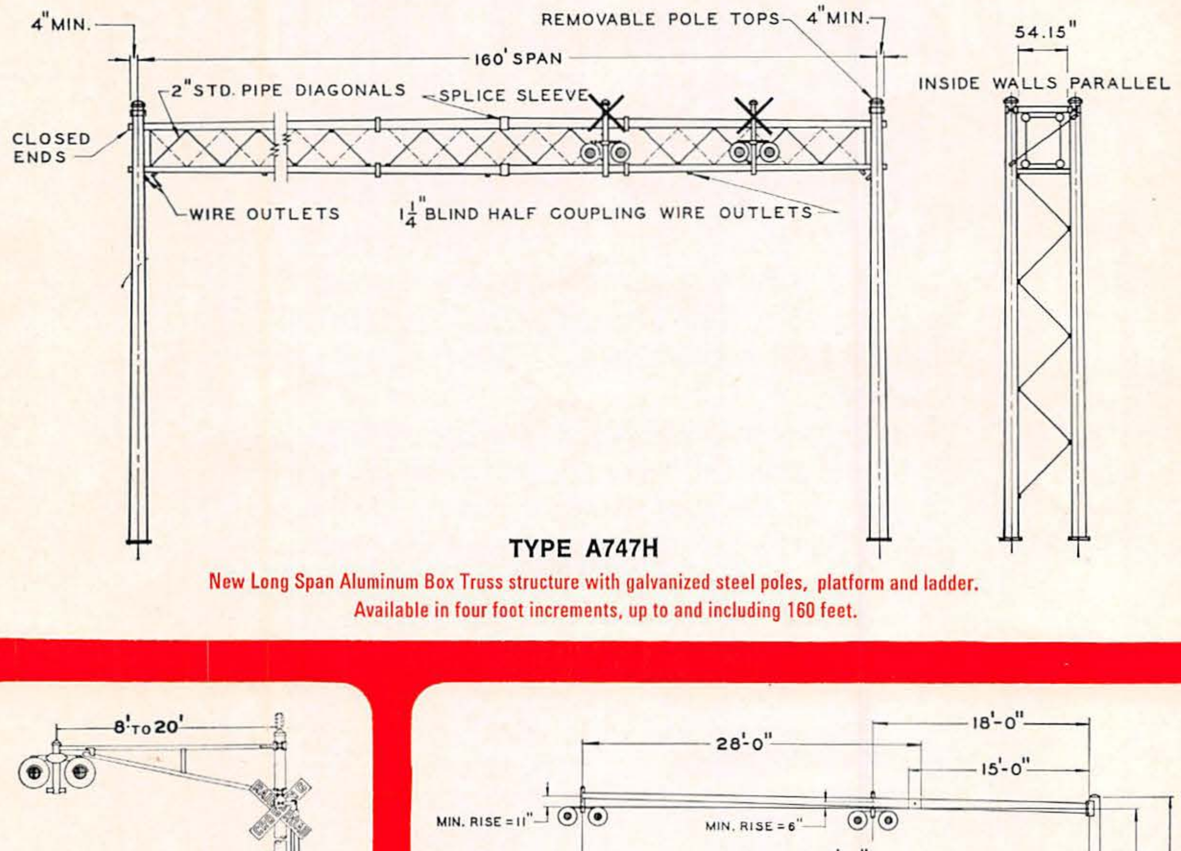
A Division of Communications Industries
908 Dragon Street • Dallas, Texas 75207
Phone 214/742-7231

Circle 2 on reader service card on page 78

WESTERN

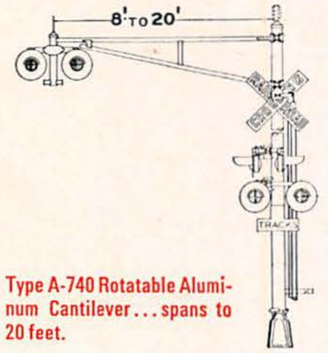
The Long-Span Structure SPECIALIST

Gives you signal supports that are high, wide and then some! Lighter-in-weight, easier to install and maintain!

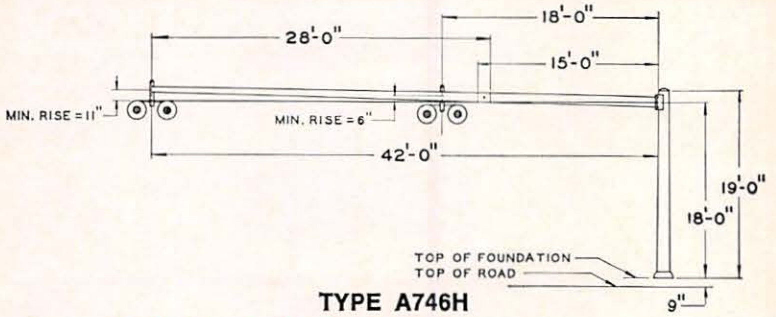

4" MIN.
REMOVABLE POLE TOPS
4" MIN.
54.15"
160' SPAN
2" STD. PIPE DIAGONALS
SPLICE SLEEVE
INSIDE WALLS PARALLEL
CLOSED ENDS
WIRE OUTLETS
$1\frac{1}{4}$" BLIND HALF COUPLING WIRE OUTLETS

TYPE A747H

New Long Span Aluminum Box Truss structure with galvanized steel poles, platform and ladder. Available in four foot increments, up to and including 160 feet.


8' TO 20'
TRACKS

Type A-740 Rotatable Aluminum Cantilever... spans to 20 feet.


18'-0"
28'-0"
15'-0"
MIN. RISE = 11"
MIN. RISE = 6"
42'-0"
19'-0"
18'-0"
TOP OF FOUNDATION
TOP OF ROAD
9"

TYPE A746H

New Non-Rotatable Galvanized Steel Cantilever . . . spans to 42 feet.

Whatever Your Far-Reaching Crossing Protection Problem . . .
Let's talk it over . . . See you at Booths 18-20

WESTERN RAILROAD SUPPLY COMPANY
Division of Western Industries, Inc.
2742 West 36th Place • Chicago, Illinois 60632
CANADA: Lyman Tube & Supply Company, Ltd., 5420 Pare St. Montreal 9, Quebec
Circle 3 on reader service card on page 78

3973A